SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JUNE, 1930.

GENERAL PHYSICS.

2055. Annular Spherometers. A. Biot. *Ann. Soc. Sci. de Bruxelles*, 49. *pp.* 251–257, *Dec.*, 1929.

The author discusses fully the accuracy obtainable with the usual type of annular spherometer and the advantages and disadvantages attendant upon its use. In putting forward the superiority of the special form using three non-tangential spheres it is claimed that the magnitude of the likely error can be reduced to from one-fifth to one-tenth of that of the ordinary instrument, and, further, that the measurements can be more easily made. J. G. H. B.

2056. Bifilar Pendulum. P. E. Klopsteg. *Rev. Sci. Instruments*, 1. *pp.* 3–8, *Jan.*, 1930.

The ideal type of bifilar pendulum is first discussed and an expression obtained for the time of oscillation for small displacements, this being of the same form as for the simple pendulum. The errors in the expression for the simple pendulum are discussed. Values are given to show the accuracy attainable in measuring *g* with the bifilar pendulum, and the type of bifilar pendulum recommended is described in detail. R. S. R.

2057. Instrument for Measuring the Contour of Fibres and Filaments. S. G. Barker and M. H. Norris. *Journ. Sci. Instruments*, 7. *pp.* 22–24, *Jan.*, 1930.

A description of a new apparatus for the examination of the contour of fibres at any point along the length of an individual fibre. The instrument combines the principles of the Einthoven galvanometer optical system and the usual Polikeit rotator. The fibre is capable of movement between the lenses either along its length or rotationally, and the resulting image is magnified up to 500 diameters. S. G. B.

2058. Shortt Clocks at Royal Observatory, Greenwich, with Special Reference to Variation of Arc Effect. J. Jackson and W. Bowyer. *Roy. Astron. Soc., M.N.* 90. *pp.* 268–278, *Jan.*, 1930.

The clocks are Shortt 3 and 11. Changes in the rate of Shortt 3 can be largely explained by (1) theoretical change of rate with change of arc; (2) change of daily rate of 0·606 sec. for each change of 1 inch of mercury in the pressure; (3) gradually decreasing secular acceleration in the losing rate. The secular change in the period of the pendulum is shown not to be due to the normal growth of invar, but may be due to a sinking of the bob, which is of type metal. The variation in the amplitude of vibration when the case is airtight has not been explained. It is concluded that "hopes of checking the regularity of the earth's rotation have considerably increased." Tables and diagrams are given of the behaviour of the two clocks. [See also Abstract 1743 (1929).] A. S. D. M.

2059. Values for Surface Tension in a Vacuum. S. Ray. *Kolloid Zeits.* 50. *pp.* 19–21, *Jan.*, 1930.

An attempt is made in the present work to confirm experimentally the theoretical deductions of an earlier paper [see Abstract 2552 (1928)] wherein it was deduced that the height of a liquid in a capillary must be zero when measured in a vacuum. J. K.

2060. Calorimetric Study of Imbibition. H. Saini. *Helv. Phys. Acta*, 3. 1. *pp.* 3–16, 1930.

A study of the quantity of energy disengaged under the form of heat at the time of imbibition of a porous body by different liquids. This energy is great in comparison with that needed for the ascension of the liquid in the same porous body. The liberated energy can be utilised in different ways. For the purposes of experiment best blotting paper was used, which was soaked with refined petroleum, vaseline oil and distilled water. A thermoelectric battery connected with a galvanometer was used to obtain measurements, except in the case of distilled water, where a mercury thermometer was employed. The general arrangement and the thermoelectric couple are described. The results obtained are discussed and amplified by curves, and the paper ends with a summary of the conclusions reached by the author. [See also Abstract 1708 (1930).] T. C. H.

2061. Ridge at the Junction of Clean and Contaminated Liquid Surfaces. J. Satterly and R. Turnbull. *Roy. Soc. Canada, Trans.* 23, *Sect.* 3. *pp.* 95–118, *Jan.*, 1929.

Describes further investigations on (1) the "tube ridge," which precedes the surface of a liquid rising through a wetted tube [see Abstract 1441 (1920)]; (2) the "disc ridge," observed on a vertical disc rotating half immersed in a liquid [see Abstract 1127 (1928)]; (3) the "Reynolds ridge," seen to travel outwards on a liquid surface from a centre of contamination; (4) the "plate ridge," observed on a vertical plate during draining. Each ridge is studied for a variety of liquids, and of pairs of liquids in case (4). The tube ridge is found the most sensitive, and it is shown that the ridge forms most rapidly when adjacent portions of the surface have different surface tensions, owing either to contamination or to adsorption. For the plate ridge it is shown that, for the ridge to form, the liquid on the plate must possess a higher surface tension than that which is touched against the lower edge of the plate; in general, the effects are most marked when the two liquids have an interfacial tension of 20 dynes per cm. or more. The relations between speed of advance of the surface in (1) or rate of drainage in (4) and the rate of movement of the ridge are studied. Cases (2) and (4) are studied also by means of the interference fringes produced when the ridges are viewed in reflected sodium light, as described by Burdon [see Abstract 1198 (1926)]. Reference is made to Edser's theory for the phenomena. L. V. C.

2062. Effect of Temperature on the Molecular Surface Energy of Binary Mixtures. W. F. Seyer and W. S. Peck. *Am. Chem. Soc., J.* 52. *pp.* 14–23, *Jan.*, 1930.

Measurements have been made of the freezing points, densities and surface tensions of pure sulphur dioxide and of sulphur dioxide and benzene solutions, from which it is found that sulphur dioxide is associated at low temperatures. The freezing-point curve shows no compound formation. The values of the Eötvös constant for binary mixtures have been shown to be dependent upon concentration and temperature. H. H. Ho.

2063. Viscosity of Emulsions. J. O. Sibree. *Faraday Soc., Trans.* 26. *pp.* 26–36, *Jan.*, 1930.

The viscosities of emulsions of paraffin in sodium oleate solution were studied at a temperature of 21·5° C. Bromoform was used to keep the density of the emulsion the same as that of the sodium oleate solution. The viscosities were determined by the concentric cylinder designed by Hatschek, and an accurate method of temperature control was employed. The emulsions were prepared by intermittent agitation and by the method of transpiration. The results were used to test the conclusions of Hatschek on the viscosity of emulsions. F. J. B.

2064. Anomalies of Physical Properties of the Vitreous State. P. Mondain-Monval and P. Galet. *Comptes Rendus*, 190. *pp.* 120–122, *Jan.* 13, 1930.

Examines the two elements sulphur and selenium, which can be obtained in the vitreous state, in order to ascertain if similar anomalies occur in the vitreous state of these elements as occur for most glasses. A lead-weighted vertical steel needle is used with its point in contact with the sample under test, and its rate of penetration measured as the temperature is increased. For sulphur no penetration occurs until a temperature of − 21° C. is reached. Above this temperature penetration commences, and at − 10° C. occurs at the rate of several mm./sec. With selenium the same characteristics are observed, but the temperature at which penetration commences is 45° C. A sample of ordinary glass examined shows penetration at 520° C. The variations of density of the sulphur sample are also studied between − 50° C. and 10° C., and again the same change in the law is noticed, occurring, however, at − 29° C. There are only slight variations between − 29° C. and − 20° C. Thus, sulphur and selenium undergo an allotropic transformation which occurs with noticeable decrease in viscosity, increase of the dilatation coefficient and absorption of heat. R. C. F.

2065. Flow through Pipe Orifices at Low Reynolds Numbers. F. C. Johansen. *Roy. Soc., Proc.* 126. *pp.* 231–245, *Jan.* 1, 1930.

Two groups of experiments were made: (1) Visual observations of the flow of water through a sharp-edged circular orifice in a glass pipe, colouring matter being injected into the stream. Tests were made over a range of low Reynolds numbers, and photographs illustrate the stages in the gradual transition from steady to turbulent flow. (2) Pressure observations with orifices mounted in a length of smooth brass pipe, the discharge coefficients being measured, using water for Reynolds numbers above 25,000 to about 50, and using oils of high viscosity for lower numbers. The oils were used over the major portion of the steady-flow range. The effects of variation of orifice-diameter ratio on the flow pattern and the discharge coefficient were examined and many of the pressure characteristics were related to features of the flow pattern observed visually. R. S. R.

2066. Boundary-Layer Equations in Hydrodynamics. S. Goldstein. *Cambridge Phil. Soc., Proc.* 26. *pp.* 1–30, *Jan.*, 1930.

The boundary-layer equations for a steady two-dimensional motion are solved for any given initial velocity distribution (distribution along a normal to the boundary wall, downstream of which the motion is to be calculated). This initial velocity distribution is assumed expressible as a polynomial in the distance from the wall. Three cases are considered: first, when in the initial distribution the velocity vanishes at the wall, but its gradient along the normal does not; second, when the velocity in the initial distribution does not vanish at the wall; and third, when both the velocity and its normal gradient vanish at the wall (as at a point where the forward flow separates from the boundary). The solution is found as a power series in some fractional power of the distance along the wall, whose coefficients are functions of the distance from the wall to be found from ordinary differential equations. Some progress is made in the numerical calculation of these coefficients, especially in the first case. The main object was to find means for a step-by-step calculation of the velocity field in a boundary layer, and it is thought that such a procedure may possibly be successful even if laborious. The same mathematical method is used to calculate the flow behind a flat plate along a stream. The results are shown in curves in the original. AUTHOR.

2067. Hydrodynamical Inertia Coefficients. J. L. Taylor. *Phil. Mag.* 9. *pp.* 161–183, *Jan.*, 1930.

The question of the "virtual inertia" of a body immersed in fluid has acquired interest from the influence which it appears to have on the natural frequency of vibration of a ship, and most of the results have been obtained with this problem in view. Part I gives solutions for motion in two dimensions due to the translation of cylinders having various cross-sections. The results can be applied immediately to the case of vertical vibrations, since the special boundary condition appropriate to the free surface is automatically fulfilled at an axis of symmetry perpendicular to the direction of motion. Part II considers the free surface condition for the case of horizontal vibration. Part III deals with the effect of rigid boundaries, *e.g.*, as in shallow water or canals; and Part IV with the effect of the abandonment of the restriction to two-dimensional motion, and of compressibility of the fluid in a particular case—that of the circular cylinder. The inertia is generally less, in the two-dimensional case, for motion parallel to the free surface than for motion in a perpendicular direction, when the breadth of the cylinder is greater than the depth; a rigid boundary increases the inertia, as also does compressibility to a small extent, but freedom of the fluid to move in three dimensions has the effect of reducing the energy. H. H. Ho.

2068. Variation of Pressure between two Plates at Different Temperatures and Low Pressures. A. E. Martin. *Phil. Mag.* 9. *pp.* 97–130, *Jan.*, 1930.

The force on two small plates was found proportional to the temperature difference, and inversely proportional to the square of the distance apart of the plates, when this distance is large compared with the plates. Other things remaining constant, the force at first increases linearly with the pressure, and then more slowly. From the deviations from linearity, the mean free path of the gas molecules can be calculated. J. H. A.

2069. Fundamental Equation of Impact Waves upon Elastic Surfaces. L. Roy. *Comptes Rendus,* 190. *pp.* 240–242, *Jan.* 27, 1930.

The author has previously shown [see Abstract 1445 (1928)] how the energetic method, together with the use of the mobile trihedron, enables the most general equations of motion to be established for elastic surfaces. He now studies the propagation of waves upon such surfaces, and thereby derives the fundamental equation respecting impact waves. The paper is entirely mathematical. H. H. Ho.

2070. Theory of Auto-Oscillations. A. Andronow and A. Witt. *Comptes Rendus,* 190. *pp.* 256–258, *Jan.* 27, 1930.

The stationary motions of auto-oscillatory systems [see Abstract 882 (1930)] are identical with the motions described by Birkhoff (*Bull. de la Soc. Math. de France,* 40. 1912, p. 305), and in the case of two degrees of freedom they may be periodic, or quasi-periodic, or even of a more general character. In the present paper a study is made of the periodic solutions of the system of differential equations:

$$\ddot{\xi} + \omega_2^2\xi = \mu f(\xi, \dot{\xi}; \eta, \dot{\eta}; \mu), \; \ddot{\eta} + \omega_2^2\eta = \mu g(\xi, \dot{\xi}; \eta, \dot{\eta}; \mu),$$

where μ is a parameter which may be chosen arbitrarily small, and where $\dot{\xi} = \alpha\xi/dt$, etc. Such a system is obtained in the case of a triode emitter with two oscillating circuits by taking normal coordinates and only considering oscillations departing slightly from the sinusoidal form. In the case where $\mu = 0$, the equations have a periodic solution, and from physical considerations it is deduced that the auto-oscillatory motion possesses the kind of stability derived by Liapounow (*Annales de la Faculté des Sciences de Toulouse,* 9. 1907, p. 208). H. H. Ho.

2071. Elasticity in Axial Symmetry. C. Sunatani. *Tohoku Univ., Technol. Reports,* 9. 1. *pp.* 13–31, 1929. *In English.*

It is shown in this paper that, when all the conditions are symmetrical about the same axis, mass effect being taken into consideration, elastic problems can be treated two-dimensionally and can be solved easily by the introduction of two arbitrary functions by which the displacement components are expressed very simply, one of the functions being in a simple relation to the dilatation or to the rotation, and the other function being in a certain relation to the former function. The general solutions for these functions are obtained in spheroidal and in spherical coordinates, and as an example for actual problems, the elasticity of a rotating sphere, hollow or solid, is fully solved. AUTHOR.

2072. Stresses Near a Circular Hole in a Strip under Tension. R. C. J. Howland. *Roy. Soc., Phil. Trans.* 229. *pp.* 49–86, *Jan.* 6, 1930.

In the present paper the plate is supposed to be bounded by two parallel edges, and to contain a hole midway between the edges; a solution of the tension problem is sought by successive approximation. The analysis is, however, first developed for the more general case of any stress system symmetrical both about the axis of the strip and about the diameter of the hole perpendicular to the axis. General formulæ are obtained giving the coefficients of each approximation linearly in terms of those of the preceding approximation. The process used is analogous to the alternating process of Schwarz, which has been applied by Picard to the general partial differential equation of the second order. H. H. Ho.

2073. Direct and Bending Stresses in Circular Flat Plates. W. Kerr. *Roy. Techn. Coll., Glasgow, J.* 2. *pp.* 230–240, *Jan.*, 1930.

This short paper deals with the general expressions for the direct and bending stresses in circular plates and with the resemblance between them. The discussion is limited to plates of uniform thickness; and its main purpose is to cultivate and utilise the resemblance so that the two types of stress may be developed in strictly similar fashion, thus giving two general results with one mode of attack. Heat stresses due to radial and transverse temperature distributions are included. AUTHOR.

2074. Closed Algebraic Curves, and their Application to Dynamical Problems. S. Higuchi. *Phil. Mag.* 9. *pp.* 184–190, *Jan.*, 1930.

In this paper the author first deals with some closed algebraic curves, *e.g.*, circles of the higher order, their main properties being mentioned, omitting the proofs, and figures of groups of them are calculated and graphed. A few applications are then made to dynamical problems, *e.g.*, the area included by the curve, volume of revolution, and radius of gyration about an axis are calculated and tabulated. H. H. Ho.

2075. Relation between Liouville and Stäckel Integrations of Mechanical Problems. V. S. Vrkljan. *Zeits. f. Physik,* 59. 9–10. *pp.* 718–722, 1930.

It is shown that if a dynamical problem is integrable, using Liouville's theorem, then it is certainly integrable by Stäckel's theorem (method of separation of the variables in the Hamilton–Jacobi partial differential equation). The converse of this result is, however, not true. W. S. S.

2076. β-Ammonium Chloride and Related Crystals. A. Johnsen. *Preuss. Akad. Wiss. Berlin, Ber.* 24. *pp.* 492–505, 1929.

On all crystals of β-ammonium chloride grown from a solution containing also magnesium-calcium pectinate and araban—both asymmetric substances—the form {731} was always found, developed as a left-handed tetragonal trapezohedron (*i.e.*, with only the faces indicated by the indices in the order 7, 3, 1). No optical activity was shown. As, however, this enantiomorphous development invariably occurs, irrespective of the apparent purity of the solution, it is thought to be due to some unknown impurity. It is suggested that the turbidity of the α-crystals, which continues after the change back to the β-form on cooling, is due to their consisting of a pseudomorphous aggregate of many minute crystals, and is connected with the large change in volume at the transition, the density of the α-crystals being 1·285, that of the β 1·487. It is concluded that the α- and β-ammonium halides are truly isomorphous with the correspondingly constituted alkali halides, *e.g.*, potassium and cæsium chlorides (lattices Γ'_c and Γ_c) respectively, and that the β-halides belong to symmetry class O and not to O_h. C. A. S.

2077. Sols in Crystals. F. Blank and F. Urbach. *Akad. Wiss. Wien, Ber.* 138. 2*a*. 9–10. *pp.* 701–715, 1929.

Study of the solubility of gold in fused halides of the alkali metals reveals the existence of an equilibrium between the alkali halide and gold monohalide in the molten mass. The dependence of the colour of the sol on the dispersion medium, on the concentration of the gold, on the rate of cooling, and on subsequent heating was investigated with coarsely crystalline material, the sols being afterwards prepared as large single crystals. In these the quantity of gold taken up from the molten mass into the crystal was determined by micro-analysis. Under definite conditions this is proportional to the gold-content. The distribution of the particles in the crystal is shown by photographs of the ultramicroscopic image. [See also Abstract 41 (1929).] T. H. P.

2078. Form of X-Ray Diffraction Bands for Regular Crystals of Colloidal Size. C. C. Murdock. *Phys. Rev.* 35. *pp.* 8–23, *Jan.* 1, 1930.

The form of the diffraction bands of a very fine uniform crystalline powder has been computed for the (1, 0, 0), the (1, 1, 0) and the (1, 1, 1) planes for cubical and octahedral crystals of the regular system. The shape of the bands is approximately that of the Gauss error curve. Both the shape and the half-intensity breadth vary from band to band and the variations are characteristic of the shape of the crystals. There is definite correlation between the form of the band and the direction of the corresponding Bragg planes with respect to the external features of the crystal. The mean breadth of the bands is nearly the same for cubical and octahedral crystals having the same volume. The values of the constant of Scherrer's equation are in general smaller than those computed by other investigators for the cubical case. A case is found in which secondary maxima of the intensity function would be sufficiently intense to be directly observable. It is pointed out that such an effect might lead to a false interpretation of the crystal structure of a very fine crystalline powder. AUTHOR.

2079. Influence of Elastic Vibrations on the Formation of Slip Planes in Extended Single Crystals. A. Smekal. *Zeits. f. techn. Physik,* 11. 3. *pp.* 65–66, 1930.

Assuming the theoretical shear strength of the ideal crystal lattice to be 1000 times greater than the observed limiting shear stress, the energy necessary to overcome by dynamic stresses the cohesion of the lattice would be 1,000,000 times greater than that actually required to produce slip planes. The thermal and other effects of such a concentration of stress could not escape observation. It is, therefore, impossible to accept the suggestion of Tronstad [see Abstract 888 (1930)] that the difference between the shear strength estimated from the lattice theory and that actually observed is to be attributed to the action of adventitious and unobservable alternating stresses arising during the normal tensile test. A. J. M.

2080. Crystal Structures of Diphenyl Derivatives. G. L. Clark and Lucy W. Pickett. *Nat. Acad. Sci., Proc.* 16. *pp.* 20–27, *Jan.,* 1930.

A twofold interest attaches to X-ray studies of structure of diphenyl derivatives in that they offer a mode of attack on the problem of the shape and symmetry of the benzene ring, and also on that of the stereoisomerism of 2·2′–6·6′ substituted diphenyls now being intensively investigated by R. Adams and associates. In the present paper unique solutions have been reached for diphenyl, dimesityl and o-tolidine. The analysis in each case has been carried out with the use of single crystals of 1 or 2 mm. for the longest dimension. H. H. Ho.

2081. Crystal Structures of Magnesium, Zinc and Cadmium Ferrites. E. Posnjak. *Am. J. Sci.* 19. *pp.* 67–70, *Jan.,* 1930.

Powder diffraction data were obtained from magnesium, zinc and cadmium ferrites. The length of the edge of the unit cube containing eight molecules (spinel type) is for $MgO.Fe_2O_3$ 8·36 ± 0·01 Å.; for $ZnO.Fe_2O_3$ 8·41 ± 0·01 Å. and for $CdO.-Fe_2O_3$ 8·67 ± 0·01 Å. The calculated densities in the above order are 4·518, 5·349 and 5·835, while the direct determination resulted in the following values: $MgO . Fe_2O_3$ 4·481, $ZnO.Fe_2O_3$ 5·290, and $CdO.Fe_2O_3$ 5·764. AUTHOR.

2082. Rhombododecahedral Translation in Rock-Salt. L. Tokody. *Zeits. f. Krist.* 72. 5–6. *pp.* 116–119, *Jan.*, 1930.

The superiority of the cubic cleavage in rock-salt is due to the distance between adjacent layers of atoms parallel to the {100} faces being greater, and the interlinking force consequently less than between layers parallel to the {110} or {111} faces. When two opposite edges of a cube of rock-salt are compressed translation parallel to a dodecahedral {110} face occurs. This is due to alternating cleavages along cube planes, the compressing force being, as it were, resolved parallel thereto. The surface of the translation plane is, therefore, not level, but fibrous or step-like. The accompanying sound is identical with that occurring in cleavage. [See also Abstract 3239 (1929).] C. A. S.

2083. Crystal Structure of Nickel Chlorostannate Hexahydrate. L. Pauling. *Zeits. f. Krist.* 72. 5–6. *pp.* 482–492, *Jan.*, 1930. *In English.*

Spectral and Laue photographs show that the unit of structure of $NiSnCl_6,6H_2O$ is a rhombohedron with $a = 7\cdot09$ Å. and $\alpha = 96° 45'$ containing one molecule. The space-group symmetry is C_3^4 or C_{3i}^2. With the use of assumed interatomic distances a structure based on the space group C_{3i}^2 is suggested which is in satisfactory agreement with the intensities observed for a large number of X-ray reflections. This atomic arrangement is illustrated and discussed. T. H. P.

2084. Crystallographic and Optical Examination of some Compounds of the Terpene and Camphor Groups. R. Nováček. *Zeits. f. Krist.* 72. 5–6. *pp.* 419–432, *Jan.*, 1930.

Crystals of the following have been measured and their optical constants determined: (1) dextro-, (2) sandarac-, and (3) dihydrosandaracpimaric acids (rhombic bisphenoidal); (4) ethyl dextro-pimarate and (5) methyl dihydroabietate (monoclinic sphenoidal); (6) methyl sandaracpimarate, and (7) fenchyl hydrogen phthalate (rhombic), and (8) fenchyl alcohol (rhombohedral). The identity of dextro-pimaric acid from American rosin with that from other sources is established. The subjoined table summarises the results (all optical measurements are for sodium light):

a : b : c	O.A.P.*	2E	2V	α	β	γ	[α_D]
1. 0·706 : 1 : 1·893	(100)	76° 30′	47° 46′	1·556	1·564	1·606	—
2. 0·680 : 1 : 1·059	(100)	80° 2′	34° 11′	1·543	1·551	1·605	− 18·8°
3. 0·735 : 1 : 1·940	(100)	118° 20′	67° 18′	1·534	1·550	1·635	+ 23·9°
4. 0·8201 : 1 : 1·8125 ... β = 102° 39′	(010)	79° 24′	48° 0′	1·547	1·568	1·689	+ 60·25°
5. 1·448 : 1 : 1·4398 ... β = 103° 57′	(010)	80°†	49°†	1·527	1·560	1·567	—
6. 0·7018 : 1 : 2·0145 ...	(100)	36° 30′	23° 10′	1·556	1·562	1·67	− 27·91°
7. 0·8183 : 1 : 1·1988 ...	(100)	74°†	45°†	1·52†	1·566	1·613	—
8. 1 : 0·93 ...	—	—	—	ω nearly = ε = 1·525			− 5·36°

* O.A.P. = Optic axial plane. † Approximate only.

Dispersion in 4 and 7, $v > \rho$, in 5, $\rho > v$. C. A. S.

2085. Scattering Powers of the Atoms in Magnesium Oxide and Sodium Fluoride. R. W. G. Wyckoff and Alice H. Armstrong. *Zeits. f. Krist.* 72. 5–6. *pp.* 433–441, *Jan.*, 1930. *In English.*

F-curves for magnesium oxide and sodium fluoride have been determined by the method previously described [see Abstract 1310 (1930)], and from them atomic scattering curves for magnesium, sodium, oxygen and fluorine. These are compared with corresponding curves deduced from calcium and lithium fluorides, sodium chloride and magnetic oxide of iron. Results agree with previous determinations and indicate the probability that there is a real difference in the scattering power of sodium in sodium fluoride and in sodium chloride. C. A. S.

2086. Crystallographic Relationships between Potassium and Ammonium Dichromates. B. Gossner and F. Mussgnug. *Zeits. f. Krist.* 72. 5–6. *pp.* 476–481, *Jan.*, 1930.

In order to discover a relationship between the crystalline forms of triclinic potassium dichromate and monoclinic ammonium dichromate, a new representation of the potassium dichromate crystal is chosen, the *b* and *c* axes being interchanged. When this is done it is found that the axial ratios of the two salts are closely similar. X-ray investigation shows that the two salts vary in crystalline system and in the angles α, β, γ of the unit cell, but, with an equal number of molecules, a marked similarity exists in the lengths *a*, *b*, *c* of the two structural units. Thus, there is no justification for alteration of the old views concerning the crystalline forms of these two salts. T. H. P.

2087. Crystalline Structure of Phenacite, Be_2SiO_4, and Willemite, Zn_2SiO_4. W. L. Bragg and W. H. Zachariasen. *Zeits. f. Krist.* 72. 5–6. *pp.* 518–528, *Jan.*, 1930. *In English.*

The positions of silicon and oxygen atoms in phenacite have been determined [see Abstract 1261 (1927)]. The light beryllium atoms do not greatly influence the diffraction, and it was not found possible to establish their positions by X-ray analysis. All indications point to a unique arrangement of the beryllium atoms, each of which, as also each silicon atom, lies between four oxygen atoms. Each oxygen atom is at the centre of a triangle, with a silicon atom at one corner and beryllium atoms at the other two corners. The structure is thus built up of SiO_4 and BeO_4 tetrahedral groups linked by their corners, each oxygen atom being at a common corner to three separate groups. Willemite is generally regarded as isomorphous with phenacite, and X-ray analysis shows that it has the same space-group symmetry and a similar unit cell containing six molecules. If the beryllium atoms in the proposed structure for phenacite are replaced by zinc atoms, and the intensities of diffraction to be expected from such a crystal are calculated, they are found to be in good agreement for 21 planes around the [111] zone. Moreover, the structures assigned to phenacite and willemite explain a striking feature of their rotation photographs round the axis [111]. T. H. P.

2088. Röntgen Goniometer for the Investigation of Polycrystals. O. Kratky. *Zeits. f. Krist.* 72. 5–6. *pp.* 529–540, *Jan.*, 1930.

The experimental determination of exact geometrical crystal structure by means of X-rays is considered, and three forms of a Röntgen goniometer are described, which allow the exact intensity distribution over a spherical zone for at least two lattice planes to be determined by a single exposure. The instruments are compared with those of Weissenberg and Dawson, and the limits of accuracy are defined. The errors introduced by deviations of the preparation from the spherical form are discussed, and a method is outlined of correcting the largest of such errors approximately.

T. H. P.

2089. Polymorphism of Sodium Sulphate. Part III. Dilatometer Investigations. F. C. Kracek and R. E. Gibson. *J. Phys. Chem.* 34. *pp.* 188–206, *Jan.*, 1930.

The inversions of sodium sulphate fall into two distinct groups. The lower inversions occur around 200° C. and are in general irreversible in the dry salt, and the upper inversions take place about 240° C. and are apparently reversible. According to the present investigation more accurate values of the various inversion temperatures are obtained, a special dilatometer being designed for this purpose. Conditions are found under which the lower inversions proceed reversibly. The effect of water on the speed and promptitude of the transformation is also considered as well as what are the stability relations of the various phases and the sign and magnitude of the volume changes accompanying these metamorphoses. The results of the first two papers [see Abstracts 483 and 484 (1930)] are confirmed and amplified. Between 180° C. and 260° C. the changes take place slowly, and are accompanied by marked hysteresis when the salt is dry, but presence of water or a trace of H_2SO_4 leads to the inversion proceeding promptly and rapidly. The following scheme indicates the ranges of stability of each modification. The figures below the arrows indicate the temperatures of each change, and the figures above are the volume changes in cm.^{3} per gramme.

$$Na_2SO_4V \xrightleftharpoons[160^\circ\text{–}180^\circ]{0\cdot0005} Na_2SO_4IV \xrightleftharpoons[185^\circ]{-\,0\cdot0034} Na_2SO_4III \xrightleftharpoons[241^\circ]{0\cdot0070} Na_2SO_4I.$$

J. K.

2090. Crystal Structures of the Elements of the B Sub-Groups and their Connection with the Periodic Table and Atomic Structures. W. Hume-Rothery. *Phil. Mag.* 9. *pp.* 65–80, *Jan.*, 1930.

A general discussion of conditions holding in the pure crystalline elements of the B sub-groups and not necessarily in alloys. The author's main conclusion is that " It is hoped that the paper will assist in giving a general indication of the relations between the crystal structures of the B-group Elements, and the Periodic Table and Atomic structures."

W. H. Ge.

2091. Relationship between Active Centres and Loose Positions in Crystals. I. N. Stranski. *Zeits. f. Elektrochem.* 36. *pp.* 25–26, *Jan.*, 1930.

In a previous paper the author developed a point of view that the sides, corners and positions of disturbance of crystals were of importance in all changes in which the crystalline state took part [see Abstract 386 (1930)]. Cubic crystals of sodium chloride undergoing solution were considered, and the behaviour of the various portions of the crystal during solution was observed. This is discussed from the space-lattice configuration of the sodium-chloride crystal.

F. J. B.

2092. Influence of Symmetry of Solvent on Crystalline Form. G. Friedel and R. Weil. *Comptes Rendus,* 190. *pp.* 243–245, *Jan.* 27, 1930.

The symmetry of the crystal depends on both that of the crystallising substance and of the solvent from which it crystallises. An inactive solvent, possessing every possible element of symmetry, does not affect the symmetry of the solute, but an active solvent possesses neither plane nor centre of, but only complete holo-axial, symmetry. Consequently any substance ordinarily exhibiting a plane or centre of symmetry loses these when crystallised from an active solvent. Thus (using Schœnflies' notation) in the cubic system O_h becomes O, exemplified by potassium chloride, and T_d, T; in the rhombic V_h becomes V, probably exemplified by sulphur; and in the monoclinic C_{2h}, C_2. But where there is no axis of symmetry of order higher than 2, the system changes, thus tetragonal V_d becomes rhombic V; tetragonal S_4 becomes monoclinic C_2, and rhombic C_{2v}, the same, a change exemplified by calamine; and, lastly, monoclinic C_3 becomes triclinic C_1. This is not to be regarded as a new kind of merihedry, as it is not an intrinsic property of the crystallising substance alone. [See also Abstract 1315 (1930).] C. A. S.

2093. Stability of Submicrons. Solution and Formation of Crystals. W. v. Behren and J. Traube. *Zeits. f. phys. Chem.* 146. Abt. A. 1. *pp.* 1–30, *Jan.*, 1930.

Further details, illustrated also by kinematograph pictures, of previous experiments [see Abstract 487 (1930)]. In spite of Smekal's critique, the authors adhere to their opinion that their submicrons are of the order of magnitude of Smekal's lattice bricks, containing about 10,000 molecules. Such aggregates would still be ultramicroscopical. There are vectorial forces or covalencies in the large molecules of cellulose, and the ultramicroscope shows that rod-shaped crystallites tend to orient themselves in rubber when stretched. Peptisation and biological problems are also discussed. H. B.

2094. Second Genus Orbits for the Helium Atom. D. Buchanan. *Roy. Soc. Canada, Trans.* 23. *pp.* 227–245, *May*, 1929.

The second genus orbits discussed are those related to the "arc" orbits found by Rawles, in which the electrons oscillate to and fro on arcs of curves almost as though they were attached to the ends of a spring clamped at the middle. The construction of the second genus orbits is obtained and a numerical example worked out with diagram. W. S. S.

2095. From Atom to Shaped Body. V. Kohlschütter. *Kolloid Zeits.* 50. *pp.* 1–12, *Jan.*, 1930.

A lecture delivered to chemists at Krefeld in order to elucidate the influences of chemical constitution and mode of formation on the visible shapes of bodies. The term atom is used after Mendelieff to indicate the carrier of the properties of an element. The shape is characteristic of the nature of the substance; the crystal is a giant molecule, and the paper deals in particular with the chemistry of crystalline aggregates. Cases discussed are the intumescence of mercury sulphocyanide; the fibrous growth of silica and alumina; the structure of silver in hair and electrolytic grain form; the formation of crystalline segregations of calcium oxalate and carbonate (vaterite) in plants; the formation of lead trees; and in particular the structures of somatoids, microscopic organised growths, which represent the results of progressive reactions. In these somatoids one may speak of atoms of the morphologic organism in analogy to the designation of cells as atoms of an organism. H. B.

2096. Relation between Atomic Weight and Atomic Number. G. Fournier. *Comptes Rendus*, 190. *pp.* 118–119, *Jan.* 13, 1930.

Considers two series, one of which is a series of primary odd numbers up to 59, indicated by p, the other being the usual series of odd numbers up to 33, indicated by i. The sum of every number in the p series with its corresponding number in the i series, that is a $p + i$ series, when plotted as abscissæ against p, is found to possess characteristic discontinuities. Plotting on the same graph the values of one-quarter of the atomic weights as ordinates against the corresponding atomic numbers, the graph thus obtained indicates similar discontinuities to those in the first graph drawn, and the slopes of the two graphs are also identical. Only one-quarter of the atomic weight is considered, in order to enable the same scales to be used in each case. Isotopes are considered as distinct atoms of the same element in every case. The reason for the introduction of primary numbers into the intra-atomic relations is not very clear, although a possible cause is suggested. R. C. F.

2097. Delimitation of Ionic and Atomic Compounds. E. Rabinowitsch and E. Thilo. *Zeits. f. phys. Chem.* 6. *Abt. B.* 4. *pp.* 284–306, *Jan.*, 1930.

On the basis of recently determined higher ionisation potentials of many elements and more precise calculations of ionic radii, the Born-Haber cyclic process is applied to a series of new compounds and conclusions are drawn as to the stability of various theoretically possible ionic compounds. It is shown that compounds such as CCl_4, NCl_3 and the other volatile halides and hydrides cannot have an ionic basis. A number of iodides of heavy metals, *e.g.*, CdI_2, CuI, and some chlorides, *e.g.*, HgCl, show a markedly negative heat of formation; X-ray analysis shows that these compounds do not belong to the class of typical ionic compounds. Similarly it appears that the solid halogen hydrides cannot be built up on an ionic lattice. Calculations on the basis of electronic affinity, work of dissociation and ionic radius explain why the " oxygen valency " is fully employed with respect to halogens only in the first three or four groups of the periodic system, while most of the elements in the middle of the long periods are preponderatingly divalent or trivalent. A. J. M.

2098. Duration of Metastable States. J. M. Anderson. *Canad. J. of Research*, 2. *pp.* 13–24, *Jan.*, 1930.

The half-value time of absorption from metastable electronic atomic states is calculated on the hypothesis that the whole decay is due to collision phenomena. Definite assumptions, which include the atomic energy-level scheme, are made as to the efficiency of collisions and the interaction of two metastable states in these processes. The assumption adopted as the only one producing an approximation to experimental facts shows that the probability of an exchange is dependent on the absolute value of the energy difference between the states concerned. The results calculated from the final formula, for helium, neon and argon at normal and very low temperatures depend on one arbitrary constant, which is the same for all states and gases considered, and show fair agreement with any experimental values so far published. An estimate is made of the energy tolerance of a quantum transition. AUTHOR.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

2099. Frequency Distribution of Wind Elements. A. Wagner. *Gerlands Beitr. z. Geophys.* 24. 4. *pp.* 386–436, 1929.

The frequency distribution of the strength and direction of the wind is investigated. In the limiting case when the component of the velocity at right angles to the mean direction is zero the frequency distribution of wind-strength approximates to the Gaussian error-law. The greater the cross-velocity is in relation to the dispersion, the less the Gaussian law departs from Maxwell's distribution of molecular velocities in gases. Both instantaneous and mean hourly values are considered. W. A. R.

2100. Mechanism of Tornadoes. G. T. Walker. *Roy. Meteorolog. Soc., J.* 56. *pp.* 59–61; *Disc.*, 61–66, *Jan.*, 1930.

A. Wegener's theory (*Wind und Wasserhosen in Europa*) that the vital portion of a tornado is a horizontal vortex is considered insufficient, and it is suggested that it is an inclined one, due to combination of the vertical vortex, which is the essential portion of a cyclone proper, with a horizontal vortex caused by air converging towards a horizontal axis in a north-south direction. Examples thought to support the suggestion are given. The discussion is mainly occupied by comments based on a misunderstanding of a withdrawn portion of the paper. C. A. S.

2101. Physical Conditions Controlling Visibility. M. G. Bennett. *Roy. Meteorolog. Soc., J.* 56. *pp.* 1–26; *Disc.*, 26–29, *Jan.*, 1930.

The investigation was designed to provide a physical theory for forecasting visibility, and a series of field observations were made, the results of which are given and analysed as under: (*a*) Visibility: (1) Intrinsic visibility of objects; (2) Direction of object and sun; (3) Distance; (4) Humidity; (5) Pressure change; (6) Solid matter suspended in the atmosphere; (7) Wind force; (8) Wind direction; (9) Effect of height. (*b*) Illumination: (1) Random variations; (2) Diurnal variations. (*c*) Illumination and visibility. It is concluded from the data that the predominant factors are: (1) contrast of object with background, (2) concentration and nature of the atmospheric suspensoid, and, of less importance, (3) glare, (4) brightness of the object, and (5) shimmer. Night-time visibility is also considered, and Appendices are added giving details of the instruments and objects used, and of the errors due to the scales adopted in the graphical work. J. G. H. B.

2102. Connection between Diurnal Temperature Change and Radiation Losses. F. Albrecht. *Gerlands Beitr. z. Geophys.* 25. 1. *pp.* 1–35, 1930.

Registrations of temperature were obtained on bright summer days at Potsdam and Vittangi, Lapland, and showed three stages in the diurnal temperature variations of the air at a height of 1–2 m. These were (1) the formation of a surface inversion at night, (2) its removal in the morning and (3) convection of heat at noon and in the afternoon. Consideration of the factors in the loss of heat from earth to air leads to an extension of W. Schmidt's theory of air-mass exchange using the laws of heat loss for hot bodies for the boundary of the air-earth sphere. The heat flow, air to earth, is considered with Ångström's views and compared with temperatures observed. From known relations the radiation loss from the earth's surface is calculated, and from the diurnal variations in the earth the heat exchange in the earth is obtained. Evaporation appears as the balance of heat at the surface. A formula for it is found for the surface of a sandy field above which the observations were made, and the results are compared with the calculated values. Finally, a formula was obtained connecting the observed temperature variations with the data of heat balance at the earth's surface, and the exchange is calculated forfour radiation-days in four different seasons of the year. R. S. R.

2103. Evaporation. H. Köhler. *Gerlands Beitr. z. Geophys.* **24.** 2–3. *pp.* 94–116, 1929.

Stephan's evaporation formula assumes that air with constant velocity and constant humidity is streaming over the surface of the liquid. This supply of air in a free atmosphere is regulated by the *diffusivity* (*Austauschkoeffizient*). The relation between diffusivity and velocity of air is discussed, and the evaporation formula modified. The influence of mountains on the temperature of the air is attributed to diffusivity, and an equation is deduced giving the flow of heat from the ground at any height. W. A. R.

2104. Cooling-Magnitude of Katathermometer and Equivalent Temperature. M. Robitzsch. *Gerlands Beitr. z. Geophys.* **25.** 2. *pp.* 194–210, 1930.

Formulæ for the cooling-magnitudes of the dry $[A = h(T_m - T)]$ and wet $[A = d(\Theta_m - \Theta)]$ katathermometers are deduced. Here T is the true (or equilibrium) temperature of the air, T_m the mean temperature of the interval through which cooling occurs, $h = b/a$, where b is a quantity dependent on the form and material of the instrument, and $a = dt_1 . dt_2/(dt_1 - dt_2)$, where dt_1, dt_2 are the times of cooling through equal temperature intervals, $T_1 - T_m$ and $T_m - T_2$. Θ_m is the equivalent temperature, *i.e.*, the actual reading of the cooling moist thermometer, Θ the equilibrium temperature of the ventilated moist thermometer, and $d = a_1/b_1$, where a_1 and b_1 are similar quantities to a and b, but relating to the moist instrument. Full details as to the methods of arriving at these and connected formulæ are given, and the value of the resultant observations as a true guide to the nature of a climate is discussed. C. A. S.

2105. Weather Recurrences and Weather Cycles. R. Gregory. *Roy. Meteorolog. Soc. J.* 56. *pp.* 103–120, *April,* 1930. *Nature,* 125. *pp.* 132–134, *Jan.* 25, 1930.

The author discusses the work of Brückner, and points out that the cycle demonstrated by him is in fact the same as that of Buchan, and was earlier described by Francis Bacon before 1625. The Brückner cycle is far less important in this country than the 50-year cycle, as is also the 11-year sunspot cycle, the influences of which are described. Defant has suggested that the earth's atmosphere has a natural period of oscillation of 3½ years which requires a vigorous impulse to be set going, such as a violent volcanic eruption. Baxendell has been able to show that we possess more exact information about a 5·1-year cycle in British weather than about any other similar phenomenon. J. G. H. B.

2106. Mechanical Integration in Gravitation and Magnetic Problems. G. A. Gambarzeff. *Gerlands Beitr. z. Geophys.* **24.** 2–3. *pp.* 83–93, 1929.

A mechanical apparatus is described for integrating observations on disturbed gravity and magnetic fields. Owing to the known relations between magnetic and gravity potentials the apparatus can be applied to certain geological problems. W. A. R.

2107. Rayleigh Waves. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 7. *pp.* 417–435, *Dec.*, 1929. *In English.*

Rayleigh waves are generated from a splitting or a sliding surface in the interior of a solid body. The splitting or sliding surface is equivalent to a sheet of internal nuclei of disturbances. In two-dimensional movements the amplitude of the waves reaches its maximum at the upright position of the line of source if the intensity increases downwards; the amplitude is constant if the intensity of the source is constant at any depth, but if the intensity decreases with depth the amplitude is a maximum at some angle between 0° and $\pi/2$. In three-dimensional motion there is in all cases a definite angle for maximum amplitude. W. A. R.

2108. Connection between Earthquakes and Variations of the Earth's Axis. R. Spitaler. *Gerlands Beitr. z. Geophys.* 25. 1. *pp.* 118–129, 1930.

On the basis of observations of 87 earthquakes it is shown that an intimate connection exists between the change of latitude of a place at the time of the earthquake and the preceding values of the same. There generally precedes the earthquake a change of the direction of the force or elastic tension which is caused by the change of latitude, which tends to reconstitute the form of the ellipsoid of rotation corresponding to the new position of the axis of rotation. This force results temporarily and at places definitely disposed thereto in an earthquake. J. J. S.

2109. Operation of the Galitzin Seismograph. F. G. Scrase. *Meteorolog. Office Prof. Notes and Geophys. Mem.* 5. *No.* 49. [12 *pp.*], 1930.

In the Galitzin vertical seismograph the motion of the pendulum is recorded galvanometrically, and the displacement of the galvanometer is proportional to the angular velocity and not to the displacement of the pendulum. Galitzin has given the equations. The relation between the galvanometer record and the earth movement is simplified when pendulum and galvanometer have the same free period and are critically aperiodic within narrow limits. The paper shows how these conditions can be realised when the instrument is installed. The isopleth diagram gives values for the damping coefficient μ^2 of the pendulum and $\xi = T - T_1/T$, the free periods of the pendulum and the galvanometer. Owing to the change of the elastic constant of the pendulum spring with temperature changes, the pendulum drifts from its normal position, even when the spring is made of elinvar, especially at high periods. The variation can be avoided by providing two springs. But one-spring instruments may be corrected for drift by altering the turning moment of the moving system or, less well, by altering the length of the spring. H.B.

2110. Balmer Series of Hydrogen in the Solar Spectrum. A. Unsöld. *Zeits. f. Physik*, 59. 5–6. *pp.* 353–377, 1930.

Fourteen Balmer lines in the solar spectrum have been measured with a microphotometer. From measurements of the width of the lines, the number of doubly quantised hydrogen atoms in the reversing layer of the sun is calculated. From questions of thermal equilibrium a pressure of about one atmosphere is deduced. The relations of these observations to those of Adams and Russell for stars are discussed. F. S.

2111. Spectrum of the Corona. R. Mecke and R. Wildt. *Zeits. f. Physik*, 59. 7–8. *pp.* 501–507, 1930.

An enquiry into the possibility of the emission lines of the solar corona being Raman lines. A definite answer cannot be given, but if the lines are Raman lines, the scatterer is probably oxygen. The hypothesis of Raman scattering provides an explanation of the vanishing of the Fraunhofer lines in the lower layers of the corona. G. C. McV.

2112. Self-Absorption in Solar Prominences. M. Minnaert and C. Slob. *K. Akad. Amsterdam, Proc.* 33. 1. *pp.* 65–71, 1930. *In German.*

The absolute and the relative intensities of prominence lines are being investigated, and the first results refer to the two lines Hα and λ5876 of helium. Three prominences were examined at different heights, and it appears that the relation Hα/He depends upon the intensity of He, decreasing with increasing He intensity. Perepelkin, using slightly different methods, also found this correlation, but much less marked. There are three possible causes for the correlation: ionisation, extinction of resonance-lines through collisions, and self-absorption. It is shown that the two first are in contradiction with observation, but the last agrees. Self-absorption is negligible for the helium line, but strongly influences the intensity of Hα in prominences. M. A. E.

2113. Drawings and Colour Studies of Mars Made with the 7-inch Equatorial at Stockholm. K. Bohlin. *Astron. Iakttagelser Undersökning., Stockholm*, 11. 6. [11 *pp.*], 1929. *In German.*

In 1924 and 1926 visual observations were made of the planet Mars, and drawings are here reproduced which confirm the main details drawn in 1911. Chief attention, however, was paid to colour, with the aid of Zeiss colour screens, gray, red, blue and yellow. The red screen gives the sharpest details. The yellow tint, which is usually seen round the limb and seems to mingle with the red as if superposed upon it, in a greater or less degree at different times, is probably to be ascribed to the atmosphere of the planet, while the red represents its surface. The notes are given in full, and their significance is discussed. M. A. E.

2114. Galactic Rotation. H. Mineur. *Bull. Astronomique*, 5. 8. *pp.* 505–543, 1929.

The author develops Oort's equation

$$V = K - V_0 \cos (G - \lambda) + rA \sin 2 (G - G_0) + \ldots$$

in a series of spherical functions, and urges that if the research on galactic rotation is extended to stars distributed over the whole sky and not confined to the galactic plane, two interpretations are indicated if the equation is pushed to the terms of the third degree. He uses the radial velocities of 2100 near stars (of mean distance 130 parsecs) and finds from the second-degree terms an effect due to a rotation round an axis in longitude 243° (the centre of the local system in Carina), but the material is not sufficient to confirm this definitely from third-degree terms. This result he considers is in addition to that of Oort, Plaskett and Schilt, who give the rotation of the distant stars round the galactic centre at 330° in Sagittarius, and presents an analogy to the turning of the moon to the sun; the stars in the local cluster turn in the retrograde sense round the centre in the galaxy. A. S. D. M.

2115. Luminosity of Falling Stars. L. Martinozzi. *N. Cimento*, 6. *pp.* 418–422, *Dec.*, 1929.

Sikara has observed in the traces of falling stars recorded on photographic plates a regular course of change in luminosity. The author discusses the difficulty of explaining this change by the various existing theories of the cause of the luminosity, and considers that Burgatti's hypothesis that the luminosity has an electrical origin and is similar to the discharges in rarefied gases explains the observed facts better than any other [see Abstract 3297 (1929)]. It is suggested that the varying distribution of ionic density in the atmospheric layers traversed may explain the fluctuations of luminosity which are of the order of about 25 %. J. J. S.

2116. Photographic Light-Curves of Cepheid Variables. Parts II and III. L. V. Robinson. *Harvard Coll. Obs. Bull. No.* 872. *pp.* 11–21, *Jan.* 1, 1930.

Ten variables with periods between 7 and 30 days are investigated, and it is shown that stars with nearly similar periods may have dissimilar light-curves. The infrequency of periods between 8 and 10 days perhaps indicates that at that stage of development a very rapid change is taking place in the state of equilibrium which underlies Cepheid variation. Ludendorff has suggested [see Abstract 2994 (1929)] classifying Cepheids into two groups, one showing features in common with Mira-variables, and another with cluster-variables. Our present knowledge seems to justify this, with the addition of ordinary cluster-variables as another group, and possibly a fourth group with periods longer than 30 days, but these need further study. The gaps in frequency distribution between some of these groups appear to be filled by various classes of irregular variables, and a common cause probably underlies the variability of all. According to Hertzsprung, a secondary maximum in the light-curve makes its appearance in Cepheids with periods of about 6 days, and becoming gradually stronger supersedes the primary maximum at periods of slightly less than 11 days. It is here shown that a relation exists between this secondary maximum and the period, at least up to periods of 40 days. The relation between period and sharpness of rise in brightness is also considered. [See also Abstract 1794 (1930).] M. A. E.

2117. Measurement of Photographic Plates. Renaux. *Comptes Rendus*, 190. *pp.* 164–166, *Jan.* 20, 1930.

Discusses Lagrula's method of estimating, from exposed plates, the precise position of a wandering star [see Abstract 97 (1930)]. A new method of estimation is given showing that the final solutions of the equations correspond to a distribution of a number of triangles. Further, the method of dependences is shown to be too limited, and should be rejected in favour of the above universal method. R. C. F.

2118. Electrodynamic Damping in Pulsating Stars. R. Gunn. *Phys. Rev.* 35. *pp.* 107–111, *Jan.* 1, 1930.

Small radial pulsations of stars are shown to be highly damped by electrodynamic forces when the star has a magnetic field unless the star is very diffuse. The author's theory of the permanent magnetic field of the sun indicates that the field is produced by regenerative means which is initiated by a small field arising from some more fundamental mechanism. The small initial field is probably produced by the rotation of the star combined with a separation of charge, although it may conceivably arise in other ways. Thus, rotating stars will have a magnetic field and cannot pulsate, and, conversely, stars which pulsate can have no magnetic field and probably do not rotate. This is in accord with the idea that Cepheid variables, being youthful giants, are so large that they would be unstable under rotation. These considerations appear to remove the difficulties encountered by Eddington in his detailed theory of star pulsations. AUTHOR.

2119. Motions and Distribution of Interstellar Matter. J. S. Plaskett and J. A. Pearce. *Roy. Astron. Soc., M.N.* 90. *pp.* 243–268, *Jan.*, 1930.

A test of Eddington's hypothesis that for "interstellar" Ca^+ lines H and K, diffuse material in interstellar space should entail that (*a*) these lines should be present in the spectra of all star classes, and (*b*) should increase in strength with increase of stellar distance. The authors discuss previous work and make an independent determination, as evidenced in the effects of galactic rotation, by means of the relative distances of the star and of absorption in the cloud. They discuss: (1) The motions, the interstellar clouds, the material being 261 stars for which both stellar and interstellar velocities are known, two criteria being employed, (*a*) where the "interstellar lines" are sharp, narrow and strong (types O to B_2 and certain B_3 and B_5 stars), and (*b*) the relation of velocities in "*c*" stars at great distance); in other types the interstellar lines are masked by stellar. The authors find that the solar velocity is the same from the radial velocities of the clouds and of naked eye stars, and for the clouds the K term is almost zero, but + 4 km. per sec. for the same stars; that the diffuse interstellar matter partakes almost exactly of the differential motions given by a general galactic rotation. (2) They find the distribution of the interstellar clouds by division of 235 stars into different magnitude groups, which again gives the K term as zero for the clouds but not zero for the stars. There is an increase in $\bar{r}A$ and hence in $\bar{r}$ as the magnitude increases, the mean distance of the stars ($\bar{r}$) being (approximately) twice that of the clouds, supporting Eddington's hypothesis. The intensities of the lines (K) confirms this, and gives a better gauge of stellar distance than grouping by magnitudes. Solving for $\bar{r}A$ for three intensity stellar groups at distances of 600, 850 and 1600 parsecs, the ratios of $\bar{r}A$ of star groups and clouds are 2·03, 2·10 and 2·01, whose mean (2·051) taken with the similar mean (1·97) for star magnitude groups gives 2·0 as a final mean. There can be no possible doubt that Eddington's hypothesis of uniform distribution of the interstellar matter is fully confirmed. A. S. D. M.

2120. Effect of Boundary Conditions on Equilibrium of a Star. A. S. Eddington. *Roy. Astron. Soc., M.N.* 90. *pp.* 279–284, *Jan.*, 1930.

When first developing his theory of stellar equilibrium, in 1916, the author showed that the photospheric layers have no special part in determining the luminosity, and in *Internal Constitution of the Stars*, p. 124, definite figures were published. The statement remained unchallenged until Milne [see Abstract 1382 (1930)] claimed that "surface conditions have a completely dominant effect," and "in any cooling problem boundary conditions are paramount." The challenge is here taken up, and by comparing solutions for two stars with the same internal material, but very different material near the surface, it is shown that the luminosity is practically independent of the physical properties of the latter. M. A. E.

2121. Milne's Treatment of the Mass-Luminosity Problem. A. S. Eddington. *Roy. Astron. Soc., M.N.* 90. *pp.* 284–286, *Jan.*, 1930.

Milne proposes to substitute a theory of stellar luminosity for that developed by the author. His investigation is, however, solely concerned with the photosphere, and however valuable his theory of this may be, he is not justified in claiming it as a method of investigating the interior. [See also preceding Abstract.] M. A. E.

2122. Schwarzschild-Milne Model of Outer Layers of a Star. E. Hopf. *Roy. Astron. Soc., M.N.* 90. *pp.* 287–293, *Jan.*, 1930.

The Schwarzschild-Milne model of a stellar atmosphere is one of infinite optical depth, consisting of plane-parallel layers in radiative equilibrium. The principal problem is the determination of the mean radiation-intensity as a function of the optical depth measured from the surface. An exact solution of this problem is here given, and some mathematical remarks are made upon the mechanism of the method of solution by successive approximation. The exact value is deduced of the relation between effective temperature and boundary temperature, and the result offers a certain improvement on the otherwise satisfactory accuracy of Milne's approximation. The approximations of Jeans and Eddington are also compared. M. A. E.

2123. Frequency of Double Stars of Different Spectral Types and Absolute Magnitudes. E. A. Kreiken. *Roy. Astron. Soc., M.N.* 90. *pp.* 306–317, *Jan.*, 1930.

Determines the relative frequencies of the double stars of different spectral types and different absolute magnitudes. These relative frequencies are then graphically represented, and from this diagram they appear to increase from the right to the left and towards the bottom of the figure. The frequencies are all larger along the main sequence of dwarfs. The shapes of the lines of equal frequency drawn on the same diagram appear to indicate the giant series as well as the main series, whilst in the region where the gap between the two groups of stars is to be expected the frequencies are very low. These equal frequency lines probably indicate restrictions to which the stars are subjected when developing. Finally, the influence of selection is found to be negligible. [See also Abstract 1796 (1930).] R. C. F.

2124. Shih Shên's Catalogue of Stars, the Oldest Star Catalogue in the Orient. J. Ueta. *Kyoto Coll. Sci., Mem.* 13. *pp.* 35–66, *Jan.*, 1930. *In English. Kwasan Observat., Publ.* 1. *pp.* 17–48, *Jan.*, 1930. *In English.*

2125. Radiation of Free Electrons in a Coulombian Field. J. A. Gaunt. *Zeits f. Physik*, 59. 7–8. *pp.* 508–513, 1930.

In a recent work [see Abstract 3295 (1929)] Oppenheimer obtained an absorption coefficient under stellar conditions many times greater than that given by Kramers and approaching that determined from astronomical data. This is shown to be due to a mistake in the calculations. The correct value agrees with that of Kramers and thus makes a higher value of the opacity theoretically impossible. The paper is mathematical. G. C. McV.

LIGHT.

2126. Colour and its Measurement. J. Guild. *Phot. J.* 70. *pp.* 22–38, *Jan.*, 1930.

The paper sketches the facts of vision which lead up to the measurement of colour, considers the effects on colorimetric measurements of visual conditions such as field size, field brightness, adaptation and fatigue, describes in some detail the Guild colorimeter, and concludes with a brief discussion on the choice of reference primaries and a standard white. W. S. S.

2127. Model of Colour Series as Basis of Three-Colour System. K. Miescher. *Zeits. f. techn. Physik*, 11. 3. *pp.* 66–70, 1930.

In a reference to Klughardt's work [see Abstract 2139 (1929)] in which a model was formed on the 3-colour basis the scheme is said to fail since the practical results were not brought into agreement with theory. The author considers each colour as a combination of two opposed colours and the application of this scheme to the 3-colour basis leads to a separation between relative and weighted coordinates of colour, of which only the former are important in the model. An equidistant 24-step colour series is derived in which opposed colours are diametrically opposite. Purity, white content, saturation and whiteness, acquire a new basis deviating essentially from the definitions given by Exner. The practical importance of the new model is explained. R. S. R.

2128. Normal Atmospheric Dispersion as Cause of the "Green Flash" at Sunset. (Lord) Rayleigh. *Roy. Soc., Proc.* 126. *pp.* 311–318, *Jan.* 1, 1930.

Two forms of experiment are described in which a crown glass prism of 45′ angle was used to imitate and give the same dispersion as the atmosphere. Using a telescope of magnifying power unity and a sharp obscuring edge, the flash can be seen if the telescope is moved so that the image is gradually obscured. The flash seen is greenish-blue. In nature a very clear horizon is essential, and the flash is seen better with a telescope than with the naked eye, while on account of atmospheric scattering the blue is less pronounced. The ordinary dispersion of the atmosphere near the horizon appears adequate to explain the "green flash." R. S. R.

2129. Refraction of Light by Alkali Hydrides. H. Bode. *Zeits. f. phys. Chem.* 6. *Abt. B.* 4. *pp.* 251–255, *Jan.*, 1930.

All the alkali hydrides crystallise with a face-centred cubic lattice. The refractive indices of sodium and potassium hydrides have been measured: for sodium hydride, $1 \cdot 469 < n_0 < 1 \cdot 470$; for potassium hydride, $1 \cdot 452 < n_0 < 1 \cdot 454$. The molecular refractions calculated from these figures are in reasonable agreement with those determined theoretically by the method of Herzfeld and Wolf. Using the measured values of the molecular refraction of sodium and potassium hydride, the molecular refraction of the other alkali hydrides have been determined. The results obtained are also in agreement with those calculated by the method of Herzfeld and Wolf. The negative hydrogen-ion has a very large molecular refraction indicating a considerable deformation. The properties of hydrogen as an anion fall into the series $F' \rightarrow H' \rightarrow Cl$. F. J. W.

2130. Refractive Power of the Anhydrous Alkali Hydrogen Phthalates. E. Widmer. *Zeits f. Krist.* 72. 5–6. *pp.* 442–446, *Jan.*, 1930.

Crystals of the hydrogen phthalates of (1) sodium, (2) potassium, (3) rubidium, (4) cæsium and (5) ammonium have been re-measured, and their optical constants (in sodium light) have been more accurately determined. Previous results are generally confirmed, but the optic axial planes of the rubidium, cæsium and ammonium salts are parallel to *c* (001), thus contrasting with that of the potassium salt, which is parallel to *b* (010). Similarly the dispersion of the potassium salt is $\rho > v$, that of all the others being $v > \rho$. The following table summarises the optical determinations (d = density; n = refractive index; $n_m = \sqrt[3]{n_\alpha n_\beta n_\gamma}$; $\phi = (n_m^2 - 1)/(n_m^2 + 2)$; MR = molecular refraction):

	d	Refractive Indices.				2V	2E (observed) approx.	ϕ	MR
		n_α	n_β	n_γ	n_m				
1	1·577	1·485	1·661	1·668	1·602	20° 34′	32°	0·343	40·92
2	1·636	1·498	1·659	1·663	1·605	16° 24′	25°	0·344	43·04
3	1·933	1·503	1·652	1·660	1·603	24° 16′	42°	0·344	44·53
4	2·178	1·530	1·653	1·679	1·616	37° 52′	63°	0·350	47·82
5	1·415	1·510	1·658	1·673	1·612	32° 52′	62°	0·343	44·97

Calculated values for 2E are (1) 34° 40′; (2) 27° 22′; (3) 40° 32′; (4) 65° 36′ and (5) 62° 01′. Molecular volume and molecular refraction differences do not agree with those of the corresponding halides. C. A. S.

2131. Double Refraction in Cellulose Acetate and Nitrate Films. J. G. McNally and S. E. Sheppard. *J. Phys. Chem.* 34. *pp.* 165–172, *Jan.*, 1930.

An instrument suitable for the determination of the direction of orientation of micelles in transparent colloidal films is described. Both cellulose acetate and cellulose nitrate films may be isotropic, uniaxial and biaxial, and any one type may be prepared from a given acetate or nitrate according to the tensions on the film during the drying process. The conclusion is drawn that the double refraction in such films is caused by the orientation of anisotropic particles of the colloid under the influence of mechanical forces present during drying. This is supported by the observation that all films dried under no differential tension and free to contract in all directions are isotropic. T. H. P.

2132. Birefringence of Black Soap Films. K. S. Krishnan. *Indian Journ. Phys.* 4. *pp.* 385–404, Jan., 1930.

Hitherto unpublished results obtained by C. V. Raman with soap bubbles of various thicknesses placed between crossed nicols in monochromatic light are discussed. When seen through crossed nicols the edge of a black bubble is intensely luminous and the inner parts more or less dark, but with thicker bubbles the edge is darkest. A slight rotation of the analyser for exact crossing destroys the observation of the dark cross except near the luminous edges for the former, but with thicker bubbles the dark cross persists in its usual form even with considerable rotation of the analyser.

From theoretical considerations it is concluded that these differences would arise with bubbles of isotropic material of various thicknesses and they give no information regarding optical anisotropy or otherwise of black films. The investigations of Perrin and others on the structure of stratified soap films and their probable optical birefringence could not, therefore, be confirmed. R. S. R.

2133. Kerr Electrostatic Effect. E. F. Kingsbury. *Rev. Sci. Instruments*, 1. *pp.* 22-32, *Jan.*, 1930.

A theoretical discussion of the effect, considered from the standpoint of the propagation of polarised radiation. G. E. B.

2134. Absorption and Rotatory Dispersion of Tartaric Acid and Alkaline Tartrates. G. Bruhat and R. Legris. *Ann. de Physique*, 13. *pp.* 5-61, *Jan.*, 1930.

Fuller details of apparatus used and of the results obtained are given than in previous papers [see Abstract 1408 (1930)]. F. S.

2135. Beam Given by Dioptric Apparatus. W. M. Hampton. *Optical Soc., Trans.* 30. 5. *pp.* 185-205; *Disc.*, 205-206, 1928-1929.

It is shown that the light in the axial direction given by a dioptric lens using a white source can only be white if the light source is above a certain limiting size. For such light sources a simple expression is deduced for the axial beam candle-power for revolving lenses. A graphical method is given for computing the axial beam candle-power for light sources of smaller size than the critical value. This makes allowance for the variation of luminosity with wave-length for the source used. The distribution of light for directions not on the optical axis is also computed in a general way. The effect of the dispersion of the glass of the lens on the maximum distance at which satisfactory candle-power readings can be made is also considered. The case of fixed lenses is then studied, and the general solution is obtained for the intensity at any distance and in any direction for light of any colour. From this the candle-power on the horizontal plane is derived as a special case. The rest of the paper consists of numerical results for lenses of the Fresnel section in both revolving and fixed types. Tables to enable the calculation of candle-power to be made are included. AUTHOR.

2136. Measurement of Ultramicroscopic Gratings. J. T. Groosmuller and C. Lakeman. *Zeits. f. Physik*, 59. 3-4. *pp.* 215-217, 1930.

As is well known, when one grating is placed over another, interference takes place, a so-called Moiré effect being produced. In general, such effects are exhibited when any body is placed over the grating. If a fine stretched wire is placed obliquely across the grating, a Moiré effect (photographs given in paper) is produced. This is a step-like appearance, which changes with the thickness of the wire compared with an element of the grating. In the case of a microscopic grating, for example a diatom, it would be impossible to stretch a wire across of suitable dimensions, but an image of a wire can be thrown on to the grating or diatom. In this way it is easy to determine the number of lines per inch on the diatom. A sketch of the optical system required is given. T. B.

2137. Distribution of Light Intensity in a Fresnel Diffraction Pattern From a Straight Edge. T. Lyman. *Nat. Acad. Sci., Proc.* 16. *pp.* 71-74, *Jan.*, 1930.

Photographs taken with light of wave-length 4358 Å. of the diffraction patterns formed by two straight-edges were measured on a recording microphotometer, and the experimental results (which may be in error by 4%) agree satisfactorily with theory. W. H. Ge.

2138. Measurement of Diameters of Fixed Stars and of Ultra-Microscopic Particles without Forming an Image Similar to the Object. K. Kühne. *Ann. d. Physik*, 4. 2. *pp.* 215–251, *Jan.* 28, 1930.

An optical system only gives a recognisable image of an object under certain limitations, but, in any case, the "image" and "object" are related through the integral equation:

$$\phi(s) = \int K(s, t) . f(t)dt,$$

where $f(t)$ defines the form and brightness of the object as a function of position in a t-plane, whilst (s) represents the image in the corresponding s-plane. K is a function of the optical system, and the integral is taken so as to cover the whole of the object. The paper treats in detail, and with a certain amount of mathematical development, the "image" formed in general, with particular reference to the case of the interferometer. The applications made by Pokrowski and by Michelson are discussed in detail, together with Eddington's criticisms of the method of Pokrowski. It is concluded that the criticisms are not entirely justified. J. H. A.

2139. Simplified Apparatus for Ultra-Violet Microscopy. L. C. Martin and B. K. Johnson. *Journ. Sci. Instruments*, 7. *pp.* 1–7, *Jan.*, 1930.

It is possible to adapt some microscope stands of ordinary pattern for the purposes of ultra-violet microscopy by supplementing the ordinary fine adjustment with a suitable means of giving delicate elastic displacements to the stage. This may be accomplished by (*a*) suitable loading, or (*b*) a differential spring device. The displacements are calibrated by interference methods. Specimens of photo-micrographs, taken with Watson's "Service" microscope stand thus implemented, illustrate the paper. The angular displacement of the stage need not exceed one minute of arc. Authors.

2140. Theory of Iris Diaphragms. O. Mikut. *Phot. Indust.* 28. *pp.* 53–56, *Jan.* 15, and *pp.* 77–81, *Jan.* 22, 1930.

The author deals first in a general way with the construction and movement of the different parts of a diaphragm. The theory is then developed to provide (1) the radius of the circle over which a diaphragm leaf shall move, (2) the number of leaves composing the diaphragm and (3) the points of rotation and width of the leaves. These considerations are applied to the cases of a diaphragm which can be wholly or partly closed. R. S. R.

2141. Halogen Silver Photochemistry. H. Arens and W. Jessien. *Zeits f. wiss. Phot.* 27. *pp.* 273–278, *Jan.*, 1930.

Repeats the work of Schmidt and Pretschner on the gravimetric estimation of excess silver in photographic layers [see Abstract 3315 (1929)], whereby silver halide emulsions give "reduced silver" after treatment with nitric acid. The results show that Schmidt and Pretschner's conclusion that the silver exists originally in the emulsion is unlikely to be correct. Several other methods of destruction of the silver halide and also silver estimation methods do not reveal any "silver values," which should naturally be shown if the above conclusion is correct. It is considered, therefore, that the "reduced silver" is due to the interaction of the three components silver halide, gelatin and nitric acid occurring during the destruction by the nitric acid. R. C. F.

2142. Halogen Silver Photochemistry. W. Leszynski. *Zeits. f. wiss. Phot.* 27, *p.* 304, *Jan.*, 1930.

Briefly discusses the extensive results of Schmidt and Pretschner [see Abstract 3315 (1929)] and concludes that the silver of the " silver value " obtained by these investigators must occur in the emulsions in other forms than illuminated silver. R. C. F.

2143. Theory of the Latent Image. A. Steigmann. *Zeits. f. wiss. Phot.* 27. *pp.* 279–282, *Jan.*, 1930.

Briefly discusses the most important theories of the latent image, including Weigert's theory, indicating the points which are at present not satisfactorily explained. Finally, the Weigert effect is examined in the light of results obtained from a simple but important test in which the effect of a potassium cyanide solution is examined. R. C. F.

2144. Estimation of Very Small Silver Masses in Photographic Layers. F. Lühr. *Zeits. f. wiss. Phot.* 27. *pp.* 283–303, *Jan.*, 1930.

Fully describes a new method of estimating very small quantities of silver ions in gelatin photographic layers, making possible the ascertaining of traces of metallic silver. The method is a modified form of the electrometric differential method first developed by Cox for acidimetric and alkalimetric estimations. Two burettes are used titrating into two electrolytically connected vessels, and the point of equality is shown by a very sharp potential difference maximum. With silver electrodes and a 0·0001 normal KI solution it is possible to estimate 0·001 mg. of silver. In order to be able to use systems containing gelatin, only a short boiling with nitric acid is necessary, so that the gelatin is not completely destroyed. Filtrations, combustions, etc., are then unnecessary, thereby involving less risk of damage to the small silver quantities. R. C. F.

2145. Correlations between Photographic Characteristics in Normal and Solarised Regions of Exposures. A. P. H. Trivelli and E. C. Jensen. *Kodak Research Lab. Comm. No.* 406. *Frank. Inst., J.* 209. *pp.* 37–81, *Jan.*, 1930.

Many examples of correlations exist between photographic characteristics in the normal exposure region of plates and films, but so far no correlations of the same kind have been given for the region of maximum density and the first reversal of solarisation. It has been definitely stated by one or two authors that no such correlations exist. From the results of a statistical and quantitative investigation of 14 different commercial photographic emulsions it is definitely found that generally these equivalent correlations do not exist between the solarised region of exposures and the normal exposure region. Those that hold are also extremely weak. Determination of the Bravais-Pearson correlation coefficient, its probable error, and the criterion in how far the result is due to chance, constitute the quantitative investigation. From the standpoint of the concentration speck theory the correlations obtained for the normal exposure agree with this theory of the latent image. The absence of correlations between the photographic characteristics in the normal exposure and in the first reversal of the solarisation agrees with the evidence that there is only a limited action of the sensitivity speck. The few weak correlations which have been shown to exist, however, suggest that the sensitivity speck has left some influence on the photographic characteristics of the first reversal of the solarisation. Consideration of the speck theory as the action of an amicroscopic Becquerel cell enables conclusions to be drawn regarding the correlations determined, it being shown that the regression theory of solarisation agrees better with the results than does the coagulation theory. R. C. F.

2146. Capabilities of the Lumière Colour Plate. C. Schaefer and Elfriede Böhlke. *Zeits. f. techn. Physik,* 11. 2. *pp.* 39–48, 1930.

An experimental examination of the Lumière colour plate, considering the same points which were examined for the Agfa colour plate [see Abstract 1735 (1927)]. The results show that the Lumière plate does not reproduce the colours as they actually occur, the photograms differing from the original in colour tone, saturation and brightness. Yellow and red colours reproduce best. No great differences are to be found between the Lumière plate and the Agfa plate, the principal difference being, possibly, that the Agfa plate has too great a sensitivity to green light whilst the Lumière plate is too sensitive to red radiations. Further, with the Lumière plate the unreversed cycle is much less saturated than is the reversed cycle, whilst for the Agfa plate the opposite holds. R. C. F.

2147. Photometry of Rotating Ellipsoid. C. Wirtz. *Preuss. Akad. Wiss. Berlin, Ber.* 27. *pp.* 574–591, 1929.

The fluctuation in the magnitude of Uranus has been attributed to its ellipsoidal shape. The author has investigated the subject experimentally by making measurements with a stellar photometer of eight artificial planets. Four of these, having the ratios of their axes equal to 0·67, 0·8, 0·9 and 1·0 respectively, were made of matt-surfaced silver, and four of the same dimensions were made of chalk. The ratios of the magnitudes were measured at the different "phases." It was found that the silver ellipsoids gave results more in accordance with those calculated from Lambert's law of diffuse reflection, while the chalk ellipsoids followed more closely Lommel's law. J. W. T. W.

2148. New Comparison Surface Astronomical Photometer. J. Dufay. *Comptes Rendus,* 190. *pp.* 166–168, *Jan.* 20, 1930.

Briefly describes a new astronomical photometer in which the comparison surface is placed in the plane of the ocular circle. This surface consists of a white diffusing medium illuminated by the light from a small incandescent lamp after passing through a neutral wedge. The complete assembly is arranged on rails so that it can quickly be placed behind the ocular. The results of measurements on two variable stars are given, these agreeing with previously published results. The necessary comparison star in each case is chosen sufficiently near to the variable star so that the influence of the differential absorption can always be neglected. R. C. F.

2149. Fluorescence of Solutions. F. Perrin. *Ann. de Physique* 12. *pp.* 169–275, *Oct.*, 1929.

This long memoir deals with the definition and essential characteristics of fluorescence, theories of fluorescence, molecular induction, polarisation of the fluorescence of solutions and the theory of this phenomenon. It also includes a short experimental section. Thus, in alkaline solutions of fluorescein in mixtures of glycerin and water, a linear relation was established between $1/p$ (where p is the polarisation of the emitted light) and $\frac{RT}{V\eta}$ (where η is the viscosity of the solution); the fundamental polarisation p_0 had the value 0·44 and the mean life of the excited molecules was $\tau = 0{\cdot}43 \times 10^{-8}$ sec. Similar results were obtained with alkaline solutions of resorufine ($p_0 = 0{\cdot}44$, $\tau = 0{\cdot}31 \times 10^{-8}$ sec. and with acid solutions of quinine sulphate ($p_0 = 0{\cdot}46$, $\tau = 4 \times 10^{-8}$). Anthracene gave $p_0 = 0{\cdot}26$, $\tau = 25 \times 10^{-8}$. The photoluminescence (or fluorescence of long duration) of uranyl salts is also described, and the polarisation in a uranium glass was found to be $p = 0{\cdot}11$ for excitation by blue light (about 4800 Å.) and 0·07 for excitation by ultra-violet light (about 3800 Å.). The significance of these results is discussed, and applications of the theory of molecular induction to chemical kinetics (*e.g.*, negative catalysis of chain-reactions and antioxygens) are suggested. T. M. L.

2150. Ozone in Luminescence. E. L. Nichols and Frances G. Wick. *Nat. Acad. Sci., Proc.* 16. *pp.* 32–36, *Jan.*, 1930.

Experiments are described in detail which determine the subsequent effect of ozone upon materials that have previously been rendered strongly thermoluminescent by X-rays. The following substances were examined calcium sulphate, cadmium phosphate, calcites, fluorides, zinc and calcium sulphides, and sodium chloride. All these substances were found to suffer diminution of brightness after exposure to ozone. Since the action of X-rays is one of reduction, the effect of ozone is to be ascribed to partial re-oxidation. A similar result was found when kathodo-bombardment was substituted for that of X-rays. H. H. Ho.

2151. Luminescence Phenomena of the Satellites of Rubrene. Two Phosphorescent Hydrocarbons, the so-called Brown and Yellow Substances. C. Moureu, C. Dufraisse, and P. Lotte. *Comptes Rendus*, 190. *pp.* 148–149, *Jan.* 20, 1930.

These two isomeric substances, of the formula $C_{42}H_{30}$, formed along with rubrene, exhibit similar luminescence phenomena, and it is suggested that they may be identical. The colour of the so-called brown compound is due to the presence of an impurity, which is retained strongly in spite of numerous washings and recrystallisations, but is destroyed by light, leaving a yellow colour. As regards the luminescence observed when these substances are exposed to light and heated, it is not absolutely certain that oxygen plays no part in this, but the phenomenon is apparently one of phosphorescence, as the yellow substance is luminous at the ordinary temperature after sufficiently intense radiation. T. H. P.

2152. Distribution of Light between Two Absorbing Bodies. K. Weber. *Zeits. f. Elektrochem.*, 36. *pp.* 26–36, *Jan.*, 1930.

The distribution was investigated by means of Plotnikov's fluorimeter. An extinction due to fluorescence was found in addition to absorption. This induced extinction is found to depend upon the substance and to be an exponential function of the concentration. The arithmetical distribution formula is found to hold for given concentrations and combinations of substances. Photochemical methods must be adopted for extreme cases. The absorption constants at 366 $\mu\mu$ are given for æsculine, quinine sulphate, sodium naphthionate, amyl nitrite, sodium nitrite and potassium chromate, while Beer's law is found to hold for the concentrations used. F. S.

2153. Luminescence from Solidified Gases at the Temperature of Liquid Helium. L. Vegard and W. H. Keesom. *K. Akad. Amsterdam, Proc.* 33. 1. *pp.* 10–16, 1930. *Abstract of Comm. No.* 205*b from the Phys. Lab., Leiden.*

This is a continuation of previous work in which the luminescence due to high velocity kathode-rays impinging on solid nitrogen and nitrogen-neon mixtures is considered. The spectra were studied with a small and a large spectrograph and also with a large quartz instrument, a number of spectrograms being reproduced. A number of the bands observed with the latter instrument are considered in detail. The following doublets have also been observed in pure neon: 3163·6 and 3149·6, 3104·5 and 3090·5, 2906·9 and 2895·2, 2841·6 and 2830·2. F. S.

2154. Phosphorescence of Solid Argon Irradiated with Kathode Rays. J. C. McLennan, E. W. Samson and H. J. C. Ireton. *Roy. Soc., Canada, Trans.* 23. *Sect.* 3. *pp.* 25–34, *Jan.*, 1929.

If the phosphorescence of solid nitrogen irradiated with high-speed kathode rays is due to hydrogen as the active centre in a diluting medium, then it is to be expected that certain relationships should exist between the luminescence spectrum of solid nitrogen and that due to solid argon. Using high-speed kathode rays from the Coolidge tube previously employed [see Abstract 497 (1929)], the authors have examined this luminescence spectrum of solid argon. The general characteristics were found to be very similar to the spectrum obtained for solid nitrogen, but the results obtained do not preclude the possibility that different parts of the solid argon spectrum may have different origins. Two strong bands appearing in the solid argon spectrograms have the same general appearances and rates of decay as the N_1 and N_2 bands of the solid nitrogen spectrum. Further, the B series of solid nitrogen appears in the spectrum of solid argon but is shifted towards the longer wave-lengths by an average frequency difference of $\Delta\nu/10 = 11{\cdot}7$. The spectrograms of solid argon fail, however, to reveal the N_4 band and the diffuse C series of solid nitrogen, although this C series is replaced by a number of narrow bands. Thus, a large part of the solid argon spectrum has undoubtedly the same origin as the corresponding part of the spectrum of solid nitrogen. R. C. F.

2155. Light of the Night Sky: Analysis of Intensity Variations Observed at the Cape, at Canberra and in England. H. S. Jones. *Roy. Soc., Proc.* 126. *pp.* 246–259, Jan. 1, 1930.

The method of observation has been given earlier [see Abstract 3317 (1929)], and the analysis covers the periods (1) Cape 1925–9, (2) Canberra 1925–7, and (3) Terling 1923–8. Curves illustrate the variation in intensity throughout the year for each place, and for each the 6- and 12-monthly periods are shown. The amplitude at Terling is about twice that of the Cape and rather greater than that at Canberra, but at the Cape the 6-monthly component is relatively more important. There is a reversal in phase from one hemisphere to the other. Superposed irregular variations are greater at Terling and Canberra than at the Cape. Long-period variations, possibly connected with the sun-spot period, are shown at Terling, less clearly at the Cape, and are doubtful at Canberra. The diurnal variation, found at Terling, is indicated at Canberra, although requiring confirmation from further observation, but is not found at the Cape. It is concluded that the non-polar aurora, though possibly distinct from the polar aurora, is intimately related to it, to the variations of the earth's magnetic field, and to the variations in sun-spot frequency. R. S. R.

2156. Absorption Spectra and New Terms in Arc Spectra of Bi and Sb Vapours. F. Charola. *Univ. Nac. La Plata, Estudio Ciencias, No.* 89. *pp.* 205–220, *Dec.*, 1929.

The absorption spectra of Bi vapour was examined between 800° and 1500°, and for Sb vapour between 1000° and 2000°. The temperature was measured with an optical pyrometer. The results are in accordance with those of Narayan and Rao for Sb, and those of Ruark, Mohler, Foote and Chenault and Narayan and Rao, for Bi. The equation $\frac{N'}{N} = e^{-E/RT}$, where N' is the number of excited atoms and N the total number of atoms, is in perfect accordance with experimental results and also with the previsions of Hund's theory. In the case of Bi all absorption lines are originated in the fundamental level ^4S; in the case of Sb, in addition to the lines of ^4S level, some lines originated in the lowest levels ^2D were observed. Twenty-five new terms in the arc spectra of Sb and 17 in the arc spectra of Bi are established. For some terms of both spectra the probable values of quantum numbers l and j are assigned, according to selection rules. AUTHOR.

2157. Absorption Spectra of Cobalt Salts in Concentrated Solutions. P. Vaillant. *Comptes Rendus*, 190. *pp* 170–172, *Jan.* 20, 1930.

Previous results for $CoCl_2$ have shown that the deviations from Beer's law can be explained by a Kundt's displacement and a change of intensity of the absorption band [see Abstract 1445 (1930)]. In the present paper results are given for an analogous comparison of solutions containing different anions using the same method as previously employed, with the exception that the thickness of solution is regulated to maintain constant intensities of the absorption bands in each case. The solutions examined are $2N$ aqueous solutions of cobalt chloride and nitrate, a $0 \cdot 1N$ aqueous solution of cobalt sulphate, and $0 \cdot 2N$ solutions of nitrate in very concentrated zinc chloride and sulphate solutions. The modifications introduced into the absorption spectrum by the substitution of one anion by another, the changing of the concentration, or the variation of the solvent, are shown to be due to a Kundt's displacement and to a change of intensity which increases as the dissociation decreases, thereby substantiating the previous results. R. C. F.

2158. Absorption Spectra of Dye-Stuff-Gelatin Films before and after Exposure to Daylight. F. Leiber. *Kolloid. Zeits.* 50. *pp.* 68–74, *Jan.*, 1930.

This work is of interest in connection with photographic light filters. The extreme differences between various light filters prepared from gelatin films coloured with organic dyestuffs are noted and qualitatively determined and recorded in the form of tables. The absorption spectra of these filters before and after exposure to daylight are also recorded in the form of curves. J. K.

2159. Ultra-Violet Absorption of Inorganic Salt Solutions. Part I. Absorption of Chlorides. J. v. Koczkás. *Zeits. f. Physik*, 59. 3–4. *pp.* 274–288, 1930.

Aqueous solutions of the chlorides of Ba, Ca, and Sr exhibit selective absorption bands in the middle ultra-violet region. The author's observations are somewhat at variance with those of Getman [see Abstract 2251 (1925)], who found that aqueous barium chloride solutions show no selective absorption, and that solutions of Mn, Zn and Al chlorides give sharp selective bands, whereas such bands are actually weak and indistinct. For aqueous solutions of the alkaline earth chlorides the head of the absorption band is at $\lambda = 2690$ Å., and the molecular extinction coefficient is greatest with barium chloride and least with calcium chloride. Lambert's and Beer's laws hold for nickel chloride, only the former holding with cupric chloride, and neither for ferric chloride. T. H. P.

2160. Absorption Spectra and Dispersion of Phosphors. W. Koch. *Zeits f. Physik*, 59. 5–6. *pp.* 378–385, 1930.

The absorption spectra and anomalous dispersion of alkali-halogen phosphors are discussed and the number of dispersion electrons calculated from the height and half-width of the absorption band and also from the range of anomalous dispersion. The applicability of each method is considered. F. S.

2161. Influence of Foreign Gases on the Absorption Spectrum of Nitric Oxide. M. Lambrey. *Comptes Rendus*, 190. *pp.* 261–263, *Jan.* 27, 1930.

The optical density of a constant thickness of NO under various pressures "p" has been shown to have the form $d = k \, . \, p^{1 \cdot 81}$ where "k" is a constant [see Abstract 1030 (1930)]. Foreign gases are known to affect the absorption of NO, and the law of the increase in absorption produced by the addition of a foreign gas is theoretically developed. This is obtained by considering a mixture of NO under a pressure "p" and a non-absorbing gas under a pressure "π" and determining the pressure "p'", of pure NO, in the same tube, necessary to produce the same absorption. The law for the variation of density with pressure has the form $d = k \, . \, p^{1 \cdot 81} [1+f(\pi, p)]$ where $f(\pi, p)=k'(\pi/p)^x$, k' and x being constants. Measurements on the (0, 0) band of the γ system for mixtures of NO with H, N, A and CO_2 show that "x" does not depend on the foreign gas introduced, but always has the value of approximately 0·90, whilst "k'" is 0·87 for CO_2, 0·91 for A, 0·87 for N, and 0·69 for H. The formula given is, therefore, $d = ap^{1 \cdot 80} + bp^{0 \cdot 90} \pi^{0 \cdot 90}$. The mixture of an absorbing gas such as NO_2 with NO also produces an increase in the optical density of the latter, shown by a spectroscopic study of the chemical equilibrium $2NO_2 \rightleftharpoons 2NO + O_2$. R. C. F.

2162. Infra-Red Investigations of Molecular Structure. Part IV. The Overtone of Nitric Oxide. C. P. Snow and E. K. Rideal. *Roy. Soc., Proc.* 126. *pp.* 355–359, *Jan.* 1, 1930.

The overtone of $NO(n'' = \frac{1}{2} \rightarrow n' = \frac{3}{2})$ was detected and partially resolved. It is of the same general character as the fundamental. It consists of P, Q and R branches, in agreement with the $^2\Pi$ state of the molecule. The constants ω_0 and $\omega_0 x$ are evaluated, and are in fair agreement with the electronic spectral values. The ratio of the intensities of the overtone and fundamental is compared with the theoretical value. [See also Abstract 1066 (1930).] J. J. S.

2163. Intensity Relations of Nitric Oxide Bands. R. Schmid. *Zeits. f. Physik*, 59. 11–12. *pp.* 850–856, 1930.

The intensity distribution in the different parts of the γ-NO bands has previously been calculated [see Abstract 3066 (1929)] from the effective temperature of emission, using Hill and van Vleck's formula [see Abstract 58 (1929)]. In the present paper a comparison is drawn between these calculated values and values obtained from quantitative intensity measurements. The comparison shows that the Hill and van Vleck formula is not suitable for fine structures, as has already been shown by Kapuściński and Eymers [see Abstract 2486 (1929)]. Finally, the measured relative intensities of the β_1, γ_1, and δ_1 band heads in the far ultra-violet are given. R. C. F.

2164. Dispersion Frequencies of Alkali Halides in the Schumann Region. R. Hilsch and R. W. Pohl. *Zeits. f. Physik,* 59. 11–12. *pp.* 812–819, 1930.

A double monochromator is described by means of which absorption spectra can be measured to 160 mμ, using direct photoelectric photometry. Measurements have been made on thin crystal layers of the absorption spectra of the iodides and bromides of all the alkali metals, and the chlorides of cæsium, rubidium and potassium. A table containing the results is given, with intensity curves for the different substances. The energy differences are compared between bands 1 and 4 of the iodides with the excitation voltages of the alkali metal atoms. They are in each case of the same order, and it appears to be suggested that for the fourth band the photographic elementary process ends with an excited and not with a neutral atom. Other relations between the energies observed are discussed. [See also Abstract 634 (1930).] H. N. A.

2165. Vibration Spectrum of Ammonia. J. W. Ellis. *Frank. Inst., J.* 208. *pp.* 507–519, *Oct.*, 1929.

The infra-red absorption spectrum of ammonia in carbon tetrachloride and aqueous solutions was studied with a registering quartz spectrograph, and the visible spectrum absorbed by an aqueous solution was examined with a Hilger E1 spectrograph. The absorption bands so obtained are analogous to the gaseous ammonia bands. The positions of some of the bands depend upon the solvent. A series of bands 2·916, 1·51, 1·035, 0·795, 0·652 and 0·556 μ did not vary with the nature of the solvent. These may be linked together with the formula $\nu_n = 97 + 3400n - 70n^2$. They are attributed to anharmonic vibrations of the N—H bond because (*a*) the energy of the oscillator (5·1 volts) calculated from the above equation is of the same order (3·99 volts) as the energy of a single N—H bond, computed chemically, and (*b*) this series of bands persists approximately in the spectra of primary and secondary organic derivatives of ammonia. The universal constant term (97 cm.$^{-1}$) is attributed to a nuclear rearrangement before or during a vibrational absorption. The whole infra-red and visible vibration spectrum of the NH_3 molecule can be built up from the three fundamental bands 10·55, 6·132 and 2·916 μ. Both the last two are attributed to the N—H linkage. A. C. M.

2166. Theory of Intermittent Action and of the Infra-Red Band Spectrum. K. C. Kar and B. Biswas. *Zeits. f. Physik,* 59. 7–8. *pp.* 570–572, 1930.

In a large number of previous papers [see Abstract 3376 (1929)] Kar has shown that his theory of intermittent action affords a very simple and logical explanation for several important problems of modern physics. The present paper extends the theory to the problem of the anharmonic oscillator, whereby the well-known formula for the infra-red band spectrum is obtained. H. H. Ho.

2167. Infra-Red Spectra of Rare Earth and other Elements. H. J. C. Ireton and Annie M. Keast. *Roy. Soc. Canada, Trans.* 23. *Sect.* 3. *pp.* 13–18, *Jan.*, 1929.

The infra-red spectra wave photographed with a constant deviation spectrograph of the elements ruthenium, rhodium, palladium, osmium, iridium, and platinum (spark spectra), and of ytterbium, praseodymium and tantalum (arc spectra). Many lines were observed; these are tabulated, and photographs are given in the cases of palladium and ytterbium. A. C. M.

2168. Form and Width of Infra-Red Lines and Third Isotope of Chlorine. H. Becker. *Zeits. f. Physik,* 59. 9–10. *pp.* 583–602, 1930.

A grating spectrometer was used to measure the absorption of the HCl line at 1·7465 μ for pressures of 3, 5, 7, 9 and 11 atmospheres. A half-width of line of 8·65, 14·0, 17·1, 21·75 and 25·1 Å. is calculated. A pure Lorentz width of 1·87 Å. is deduced and a molecular diameter of 10·7 Å. A decrease of line intensity with increasing pressure is found, from which the presence of a third isotope of chlorine of mass 39 is inferred. F. S.

2169. Vibrational Quantum Analysis and Isotope Effect for Lead Oxide Band Spectra. S. Bloomenthal. *Phys. Rev.* 35. *pp.* 34–45, *Jan.* 1, 1930.

Each strong line ($Pb^{206}O$) in the band spectrum emitted by a uranium lead arc in air is represented by three lines ($Pb^{208,\ 207,\ 206}O$ with relative intensities in agreement with Aston) in the band spectrum from an ordinary lead arc. The first and second orders of a 21-ft. Rowland grating were used to make this comparison. The observed separations between corresponding band lines of isotopic molecules are in good agreement with the theory of the isotope effect in band spectra with PbO as the emitter. New measurements of the wave-lengths of the band heads were made from moderate dispersion spectrograms of the ordinary lead arc in air. The bands in the near ultra-violet form a new system:

$$\nu = 30{,}197\cdot 0 + [530\cdot 6(v' + \tfrac{1}{2}) - 1\cdot 05(v' + \tfrac{1}{2})^2] - [722\cdot 3(v'' + \tfrac{1}{2}) - 3\cdot 73(v'' + \tfrac{1}{2})^2],$$

in which ν represents the vibrational quantum number. Three other systems in the visible have been discussed already by Mecke. Evidence in favour of combining two of these systems (C and B) into one is presented. All of the band systems have a common lower state. [See also following Abstract.] AUTHOR.

2170. Fine Structure Analysis of the Bands in the A and D Systems of Lead Oxide. A. Christy and S. Bloomenthal. *Phys. Rev.* 35. *pp.* 46–50, *Jan.* 1, 1930.

The bands of the A and D systems of PbO are composed of single R and P branches only. The combination principle has been applied to the lines of these branches and the rotational constants of the molecule have been determined. The bands of PbO have been assigned previously to three systems, A, B, and D, all three having the final state in common. The nuclear separation of this final state is found to be $1\cdot 9207 \times 10^{-8}$ cm, that of the upper state of A, $2\cdot 0927 \times 10^{-8}$ cm, and of the upper state of D, $2\cdot 0424 \times 10^{-8}$ cm. No Q branches have been found in either of the two systems, indicating that all the electron states involved have the same value of A. It is shown that the electronic levels of the two systems investigated are singlets. All the electron states involved are, in all probability, $^1\Sigma$ states. [See also preceding Abstract.] AUTHORS.

2171. Band Spectrum of Lithium Hydride. G. Nakamura.

Zeits. f. Physik, 59. 3–4. *pp.* 218–242, 1930.

The investigation of the band spectrum of lithium hydride is especially interesting since the molecule contains the same number of electrons as the systems He_2, BeH and Be. The present paper is a continuation of an earlier one [see Abstract 2752 (1929)], and embodies a number of new results. A great number of the absorption lines coincide with the emission lines found by W. Watson, but the absorption spectrum is much simpler. Each branch consists of a P and an R branch which shade off towards the red. A Hilger grating of 3-m. radius was used to obtain the spectra and the light source was a lithium arc in hydrogen of 3- to 5-cm. pressure. The voltage used was 440 volts and the current 0·8 to 1·5 amp. A steel tube closed with quartz windows and containing LiH which could be strongly heated was used as the absorption tube. Ten pages of wave-lengths and intensities are given. An analysis of the results gives for the moment of inertia in the normal state a value $3 \cdot 7 \times 10^{-40}$ g.cm.^{2} and for the excited molecule the value $9 \cdot 3 \times 10^{-40}$. These correspond to a nuclear distance of $1 \cdot 6 \times 10^{-8}$ cm. The work of dissociation is 59 k. cal.

T. B.

2172. Band Spectrum of Cadmium Hydride. E. Svensson.

Zeits. f. Physik, 59. 5–6. *pp.* 333–352, 1930.

The various band systems of cadmium hydride have been investigated—the first known, $^2\Pi \rightarrow {}^2\Sigma$, between λ3800 and λ5600, that similar to the HgH system between λ2900 and λ3500 ($^2\Sigma' \rightarrow {}^2\Sigma$), and a few bands of a third system, probably $^2\Sigma'' \rightarrow {}^2\Pi_{\frac{1}{2}}$. The various systems are discussed in connection with Hund's theory of molecular spectra. F. S.

2173. Band Spectrum of Aluminium Hydride. E. Bengtsson and R. Rydberg.

Zeits. f. Physik, 59. 7–8. *pp.* 540–557, 1930.

A new band λ2033 has been found and is attributed to electron jumps $'\Sigma'' \rightarrow {}'\Sigma$. Also new bands λ4546 and λ4671 in the system $'\Pi \rightarrow {}'\Sigma$. Known bands are also remeasured. The intensity of the bands for various densities of hydrogen is studied. Dissociation values are given calculated by comparing the terms of AlH on the one hand, and the terms of the Al atoms on the other. Finally, the intensity-ratio for different parts of a given band is discussed. G. C. McV.

2174. Raman Effect in Certain Organic Compounds. J. Söderqvist.

Zeits. f. Physik, 59. 7–8. *pp.* 446–465, 1930.

Benzol, toluol, ethyl benzol, ethyl chloride, ethyl bromide, allyl chloride, normal propyl chloride and normal propyl bromide have been investigated, and the results are compared with those of other observers. These substances in many cases give similar Raman frequencies, particularly when they have similar structure. Pringsheim and Rosen have already called attention to a Raman frequency of about 3050 cm.$^{-1}$, corresponding to a wave-length of $3 \cdot 3\ \mu$, which is found in organic substances containing the CH-link; it really differs a little in aromatic and aliphatic compounds having a wave-length about $3 \cdot 27\ \mu$ in the first and $3 \cdot 37\ \mu$ in the second. In addition, the aromatic compounds investigated give a wave-length nearly twice as great as this, while Dadieu and Kohlrausch give 10μ and 16μ as characteristic values for the simple ring formation; this agrees well with the author's results for benzol, toluol and ethyl benzol. A frequent Raman line with wave number about 2920 cm.$^{-1}$ and wave-length 3·40μ occurs with substances containing the CH_3 group; both aromatic and aliphatic compounds give the same wave-length. A wave-length of about 8·5μ is found with the aromatic substances investigated, but further work is required on this. Chlorides and bromides of the fatty acids have in many cases similar lines; in the cases of propyl chloride and bromide the wave-lengths for the latter are in all cases a little longer than those for the former. H. N. A.

2175. Raman Effect in Liquid Pyridine. S. Venkateswaran. *J. Phys. Chem.* 34. *pp.* 145–152, *Jan.*, 1930.

The mercury spectrum was used as source and photographs taken with a quartz spectrograph. Lines were found corresponding to emissions in the infra-red at 16·58μ, 15·36μ, 11·32μ, 10·12μ, 9·735μ, 8·214μ, 6·343μ and 3·271μ. The various modified lines are differently polarised, while the strongest lines corresponding to 10·12μ and 9·735μ are most strongly polarised. From a comparison of the effect in benzene and pyridine, it is suggested that the two have a similar structure. F. S.

2176. Raman Effect with Liquid Hydrogen. J. C. McLennan and J. H. McLeod. *Roy. Soc. Canada, Trans.* 23, *Sect.* 3. *pp.* 19–20, *Jan.*, 1929.

Lines at λλ4426·8 Å. and 4472·1 Å. due to μ4358·3 Å. line of mercury and a line at 4863·5 Å. due to 4046·6 Å. were observed. The first two correspond to 0 → 2 and 1 → 3 rotational transitions and the latter to a 0 → 1 vibrational transition of the hydrogen molecule in the zero vibrational state. They constitute a series of violations of generally accepted selection rules. F. S.

2177. Raman Effect in α- and β-Hydrogen. J. C. McLennan, H. D. Smith and J. O. Wilhelm. *Roy. Soc. Canada, Trans.* 23. *pp.* 247–253, *May*, 1929.

The transformation from β- to α-hydrogen proceeds slowly in liquid hydrogen with age, so that the concentration of α-hydrogen increases. This was shown by Bonhoeffer and Harteck [see Abstract 3432 (1929)] and also by Eucken and Hiller [see Abstract 250 (1930)]. This is now confirmed, by observing the lines scattered by liquid hydrogen taken from the same stock (*a*) freshly prepared, (*b*) 24 hours old, (*c*) 48 hours old. The molecular transitions due to β-hydrogen (odd rotational levels) gradually weakened, while the molecular transitions due to α-hydrogen (even rotational levels) gradually strengthened. A. C. M.

2178. Raman Effect in Liquid Methane. J. C. McLennan, H. D. Smith and J. O. Wilhelm. *Roy. Soc. Canada, Trans.* 23. *pp.* 279–282, *May*, 1929.

Raman lines were found bearing a frequency separation from the exciting lines of 2909 and 3071 wave-numbers (cm.$^{-1}$). In addition, there was a weak band, with lines at approximately 2953, 2999, 3023, and 3047 cm^{-1}. A. C. M.

2179. Continuous Gas Spectra. W. Finkelnburg. *Phys. Zeits.* 31. *pp.* 1–25, *Jan.* 1, 1930.

The paper constitutes a *résumé* of present knowledge concerning continuous gas spectra. The continuous spectra associated with atom boundaries are considered first, and then those corresponding for molecules including predissociation spectra. The continuous spectra of the halogens, of hydrogen, of mercury and other metallic vapours, of comets and the sun's corona, and, finally, those due to temperature and pressure, are discussed in turn. A Bibliography of 323 references concludes the paper. F. S.

2180. Intensity Maxima in the Continuous Helium Spectrum. Jane M. Dewey. *Phys. Rev.* 35. *pp.* 155–157, *Jan.* 15, 1930.

The position of the maxima of the continuous spectrum of helium was measured with an arc in which measurements of ion concentration were made. The displacement of the maxima to the red by stray fields in the gas was calculated from the formula $E = -2e(eF)^{1/2}$ given by Robertson and Dewey and more recently by Kudar. The observed displacement is always larger than the calculated. Reasons for this are discussed. AUTHOR.

2181. Intensities in the Helium Spectrum as a Function of Pressure and Electron Velocity. W. Elenbaas. *K. Akad. Amsterdam, Proc.* 32. 10. *pp.* 1334–1344, 1929. *Zeits. f. Physik,* 59. 5–6. *pp.* 289–305, 1930.

Continues the investigation described in a recent paper by Peteri and Elenbaas [see Abstract 2184 (1929)] with an improved form of triode tube and a new method for comparing the intensity of different lines. The excitation functions of the visible lines were measured at pressures of 0·1 mm. and 0·04 mm. All lines show two maxima, except those of the triplet principal and sharp subsidiary series, which have one sharp maximum. Lines of the same series have similar excitation curves. The ratio between the intensities at the above pressures increases with the electron velocity, particularly for the diffuse subsidiary series. The triplet-singlet ratio increases with decreasing electron velocity especially the ratio $(2^3S - 3^3P)/(2^1S - 3^1P)$. The excitation curves at 0·04 mm. pressure fall off in intensity after the maximum more steeply than at 0·1 mm. pressure. The triplet-singlet ratio shows a slight increase with pressure. The spark line 4686 Å. is not found below 75 volts; this means that the concentration of He ions is very low at these voltages. The degree of polarisation P was found to be zero at excitation potential, and to have a maximum at approximately double this voltage. P for helium was always positive; probably it would become negative as in the case of Hg for higher electron velocities. [See also following Abstract.] H. N. A.

2182. Optical Determination of Sphere of Action of Helium Atoms for Electrons. L. S. Ornstein and W. Elenbaas. *K. Akad. Amsterdam, Proc.* 32. 10. *pp.* 1345–1351, 1929. *Zeits f. Physik,* 59. 5–6. *pp.* 306–312, 1930.

Observations were made with the discharge tube used in the investigation of the excitation function previously dealt with [see preceding Abstract]. This employed a cylindrical anode, with a slit on one side through which the light produced in the interior of the cylinder could be observed. A sharp image of this slit was formed on the slit of the spectrograph, and the intensities at different points in a spectral line were compared by photometry. The intensity along the observation slit can be expected to fall off as $\varepsilon^{-x/\lambda}$, owing to reduction of the number of electrons in the stream due to collisions with He atoms, although this formula may be modified by back diffusion, and by reflection from the end of the anode cylinder. The authors find that for 30-volt electrons the Ramsauer effective cross-section of the helium atom is about 9 cM^2/cM^3. H. N. A.

2183. Series of Combination Lines in the Neon Spectrum. N. Ryde. *Zeits. f. Physik,* 59. 11–12. *pp.* 836–846, 1930.

The combination lines of neon produced in an electrical field, using the Stark and the lo Surdo methods, have been investigated. More than 100 forbidden lines between 5800 and 4250 Å. have been observed and identified, and thus the previous investigations of Foster and Rowles have been extended. For certain combinations of the types $p-nf$ and $p-ng$ from among these lines, the wave-lengths in the absence of a field have been obtained by extrapolation. Since the p-terms are known, it is then possible to estimate the magnitude of the Bergmann and super-Bergmann terms, which otherwise are difficult to determine. Systematises the types of groups of lines appearing in an electrical field, and shows that for certain $p-np$ combination lines the electrical shift $\Delta\lambda$ varies as the square of the field intensity. H. N. A.

2184. Blue Argon Spectrum. A. H. Rosenthal. *Ann. d. Physik,* 4. 1. *pp.* 49–81, *Jan.* 18, 1930.

The region extending from 2100 to 2400 Å. was mapped by means of a Hilger quartz spectrograph, and the region from 2400 to 9000 Å. by means of a 3 m. Rowland concave grating. Some 1500 lines are tabulated to within one part in a million, including a large number of new lines, and 14 new terms are calculated. E. E. F. d'A.

2185. Arc Spectrum of Xenon. W. Gremmer. *Zeits. f. Physik,* 59. 3–4. *pp.* 154–167, 1930. *From the Reichsanstalt.*

The arc spectrum of Xe was photographed using a 4 m. grating. A great number of the lines have been arranged in series following the observation of a number of constant differences. The spectrum has a similar structure to those of Ne, A and Kr. Following Paschen's investigation of neon, 4s-terms, 10p-terms and four series of H-like terms have been found. Many lines correspond to combinations of these terms. An ionisation potential of 12·06 volts is deduced, in good agreement with Abbink and Dorgelo's value. F. S.

2186. New Bands in the Secondary Spectrum of Hydrogen. D. B. Deodhar. *Phil. Mag.* 8. *pp.* 37–49, *Jan.*, 1930.

Continuation of the work by the author on the bands in the secondary spectrum of hydrogen [see Abstract 145 (1929)]. Seven new bands in the blue region are discussed, and tables of terms, etc., are given. The term differences are used to calculate the moments of inertia of the molecules emitting the bands, in the initial and final states. These are also tabulated. G. C. McV.

2187. Search for New Bands of CN, N_2^+ and BeF. R. K. Asundi. *Indian Journ. Phys.* 4. *pp.* 367–384, *Jan.*, 1930.

The search was initiated as a result of Mulliken's paper on one-valence-electron emitters. The recent work of Hund and Mulliken on such systems is discussed, and the near infra-red region chosen as a likely field of research. The experimental work was conducted with a constant-deviation spectrograph using neocyanine plates. The spectrum of cyanogen was produced by the action of active nitrogen on chloroform. The band heads found are listed and discussed. A discharge excited by 600 volts was used for investigation of nitrogen, but no new bands were found. Some close bands were found for BeF, which it is proposed to investigate further with higher dispersion. F. S.

2188. Intensity Measurements in the Nitrogen Band Spectrum. W. R. van Wijk. *K. Akad. Amsterdam, Proc.* 32. 9. *pp.* 1243–1247, 1929. *Zeits. f. Physik,* 59. 5–6. *pp.* 313–319, 1930.

Intensities of the lines in the negative bands were made and log I/n plotted against $n(n+1)$ which is proportional to the rotational energy of the nth state. The slope of this line gives a gas temperature of about 600° C. in the case of the 3914-Å. band, and also for those at 3883, 4278 and 4237 Å. Variation of gas pressure from 30 mm. to 0·003 mm. did not affect the results. Observations on the 3371-Å. band belonging to the second positive bands are tabulated. F. S.

2189. Transition Probability of "Forbidden Line" 2656 of Mercury. E. Gaviola. *Univ. Nac. La Plata, Estudio Ciencias, No.* 89. *pp.* 67–75, *Dec.,* 1929.

Previous measurements by R. W. Wood and the author enable calculation to be made of the relative amount of metastable mercury atoms in regard to resonance ones. This ratio is equal to one hundred under the author's conditions. The relative intensity of the forbidden line 2656 in regard to the resonance line 2537 has been measured and found to be equal to one-millionth. The transition probability of 2656 is, therefore, 10^{-8} times that of 2537. This gives for the life of the undisturbed metastable atoms in the level 2^3P_0 no less than ten seconds. This result agrees to a certain extent with a calculation of Placinteanu. The life of metastable atoms is considerably shorter (10^{-2} to 10^{-5} sec.) under laboratory conditions owing to collisions of the first and second kinds with the solid walls, and with other metastable atoms. AUTHOR.

2190. Mercury Line, $1^1S_0 - 2^1P_1$. A. T. Williams. *Univ. Nac. La Plata, Estudio Ciencias, No.* 89. *pp.* 175–179, *Dec.,* 1929.

Persistence of intercombination lines. In the spark spectrum, using Gramont's fulgurator with solutions of mercury salts, or carbon electrodes impregnated with the same salts, it is only possible to register photographically the Hg line 1859·57, working in an atmosphere of nitrogen. This line, however, presents less persistence than the lines 1942·0, $1^2S_1 - 2^2P_1$ and 2536·52, $1^1S_2 - 1^2P_1$, when working in nitrogen, with solutions more and more diluted. The line 1849·57 is a theoretical but not experimental " ultimate ray "; the true ultimate rays of mercury are in all conditions 2536·52 and 1942·00. A. D.

2191. Emission Spectrum of Mercury. R. G. Loyarte. *Univ. Nac. La Plata, Estudio Ciencias, No.* 89. *pp.* 111–120, *Dec.,* 1929.

Mercury spectrum examined from 1868 to 3000 Å., with the view of finding new rays originated by the combination of the leaps of luminous electrons with the rotation of the atom. Almost sixty rays were found which are not in Kayser's tables, and 19 of these differ approximately by 11,316 cm.$^{-1}$ from the other emission rays already known. These 19 are the rays sought for. A. D.

2192. Series Spectra of the Lightest Elements. A. Ericson and B. Edlén. *Zeits. f. Physik*, 59. 9–10. *pp.* 656–679, 1930.

A vacuum spectrograph is described in which a metal grating of 1 m. radius is used at a glancing angle of 10°. The intensity and resolving power are thus greatly increased, and series spectra down to 100 Å. have been obtained. Results for the first five elements are given here, tables of wave-lengths of standard and series lines, and also reproductions of spectra. Results for Be and B have already been announced [see Abstract 1453 (1930)]. F. S.

2193. Doublet Components of the Alkali Metals. E. Fermi. *Zeits. f. Physik*, 59. 9–10. *pp.* 680–686, 1930.

According to the usual rules, the ratio of intensity of the two components should be as 2 : 1. Eperimental values show notable differences, especially in the case of Cs. The present paper is a theoretical discussion of the discrepancy. F. S.

2194. Regularities in the Arc Spectrum of Hafnium (HfI). W. F. Meggers and B. F. Scribner. *Bureau of Standards, J. of Research*, 4. *pp.* 169–175, *Jan.*, 1930.

The first regularities among lines characterising the first spectrum of hafnium (HfI) have been discovered. Combinations of seven low energy levels with higher excited states account for more than 200 lines. Inner quantum numbers have been assigned to the energy levels and a tentative identification of the seven low levels is suggested. AUTHORS.

2195. Second Spark Spectrum of Lead. A. S. Rao and A. L. Narayan. *Zeits. f. Physik*, 59. 9–10. *pp.* 687–689, 1930.

This is a short note giving particulars of lines in the spectrum which have been analysed since the preliminary note by the authors and K. R. Rao was published [see Abstract 3236 (1928)]. It is pointed out that there is good agreement between the authors' work and that of Smith [see Abstract 1558 (1929)], except in respect to the change of level $1^3P - 1^3S$. A list of all lines determined is given. T. B.

2196. Method of Horizontal Comparison in the Location of Spectra of Elements. K. Majumdar. *Indian Journ. Phys.* 4. *pp.* 359–365, *Jan.*, 1930.

Discusses the spectra of the same elements as previously examined [see Abstract 176 (1929)] arising from the $xL_2(M_2 \leftarrow M_3)$ and $xM_2(N_2 \leftarrow N_3)$ transitions respectively. The spectra in these cases are much more complex, and even when the highest multiplicity lines are selected nine multiplets are obtained. Some of these are very weak and not at present obtained in many elements, so that only the three principal multiplets are considered and the strongest line from each chosen. The relations thus obtained appear more complex than the simple linear relations obtained for the other transitions, whilst the various multiplets for any particular element are not so evenly distributed about the mean as previously. R. C. F.

2197. Use of Gratings at Grazing Incidence for Spectrography of the Extreme Ultra-Violet. M. de Broglie. *Comptes Rendus*, 190. *pp.* 93–95, *Jan.* 13, 1930.

Reference is made to recent researches of Thibaud in the extreme ultra-violet and the later use of the method for X-rays of long wave-length involving the spectra of emission and absorption of normal atoms, the K and L series of light elements and the M and N series of heavy elements. This leads to the use of molecular gratings at crystal faces as tangential gratings for rays of very short wave-lengths. The γ-rays have not yet been reached, but quite recently Dempster appears to have obtained diffraction of protons with crystal surface gratings at grazing incidence. R. S. R.

2198. Condensed Spark Spectrum in the Extreme Ultra-Violet. B. Edlén and A. Ericson. *Comptes Rendus*, 190. *pp.* 116–118, *Jan.* 13, 1930.

Describes the results of experiments whereby it has been possible to photograph the BeIII ray 88·36 Å. A new type of high-tension supply is used giving a large increase in the spark current, whilst the degree of vacuum in the sparking chamber is extremely high. Using this arrangement, the resonance ray of BeIII, 100·25 Å., is very strong for five orders of the spectrum, but the BeII spectrum is found to have disappeared. Suitable variations of the current give rise to the spectra from OII to OVI and the number of lines classified in these spectra is given. Values of the ionisation potentials for OIII to OVI are calculated from the results obtained. Details of the doublets for NeI, NaII, MgIII, AlIV and SiV are also given, the first two only having been previously stated. [See also following Abstract.] R. C. F.

2199. Aluminium Spectrum in the Extreme Ultra-Violet. B. Edlén and A. Ericson. *Comptes Rendus*, 190. *pp.* 173–174, *Jan.* 20, 1930.

Using the same method as previously described [see preceding Abstract], it has been possible to obtain the spectrum of aluminium down to λ104·0 Å. Below 230 Å., although a large number of lines have been obtained, they do not agree with those measured by Millikan and Bowen [see Abstract 1466 (1924)]. Above this wave-length the agreement is better. The doublet 278·720 and 281·402 Å. is the strongest, so much so that even in the third order these rays are stronger than any oxygen lines. This doublet is part of the AlV spectrum, and the corresponding doublets for NaIII and MgIV are also given. The increase in ionisation obtained is further shown from the fact that the corresponding groups to those given by Bowen [see Abstract 1754 (1927)] for FII have been ascertained for MgV and AlVI. R. C. F.

2200. New Resonance Series of Selenium. Miss H. Grünbaum. *Acad. Polonaise Sci. et Lettres, Bull.* 10*a*. *pp.* 611–615, *Dec.*, 1929.

An attempt was made to excite new selenium series, using sparks from Zn and Cd, but it was not possible to photograph them, though some excited light could be seen. A condensed calcium spark was then employed, produced between two carbon electrodes with cavities filled with calcined $CaCl_2$, giving the lines λ3934 and λ3969. The temperature of the selenium vapour was 600° C., and the exposure lasted 50 hours. The frequencies measured can be expressed by the formulæ:

$$\nu = 25{,}430 - 382{\cdot}7m + 1{\cdot}32m^2 \text{ (exciting line, } \lambda 3934\text{)},$$
$$\nu = 25{,}194 - 376\ \ m + 1{\cdot}32m^2 \text{ (exciting line, } \lambda 3979\text{)},$$

where $m = 0$ corresponds to the re-emission of the exciting ray. Comparing the results with those of Rosen on the absorption spectra, the formulæ

$$\nu = 28{,}517 - 397{\cdot}5n - 1{\cdot}32n^2 \text{ (exciting line, } \lambda 3934\text{)},$$
$$\nu = 28{,}292 - 397{\cdot}5n - 1{\cdot}32n^2 \text{ (exciting line, } \lambda 3934\text{)},$$

can be derived, which agree with those of Rosen. Only lines which follow the Stokes law have been observed. The relations between the intensities are irregular. The diagram showing the relation between the levels of selenium given by Rosen, and extended by Miss Schmidt, has been made more complete, and it has been shown that the absorption of the exciting lines corresponds to the passage from the normal state of the molecule $n = 8$ to the excited state $n' = 5$ for λ3934 and from $n = 8$ to $n' = 4$ for λ3969. H. N. A.

2201. Resonance Series of Sulphur Vapour. P. Swings. *Comptes Rendus*, 189. *pp.* 982–983, *Dec.* 2, 1929. *Acad. Polonaise Sci. et Lettres, Bull.* 10*a*. *pp.* 616–620, *Dec.*, 1929.

A special method was employed for altering the temperature and pressure of the sulphur vapour in a quartz bulb heated in an electric furnace. A mercury lamp was employed to excite the spectrum. Good resonance series were obtained, excited by the mercury lines 3132, 3126, 3022, 2968 and 2894 Å.; all of these were measured and studied. In addition, four series of doublets D, A, B and C were obtained, excited by the lines 3655, 3132, 3126 and 2968. Some details are given with regard to the series of multiplets, with tables for the doublet series giving ν, λ, distances Δλ between the components and intensities. Using the approximate value $J = 1{\cdot}3 \,.\, 10^{-40}$ c.g.s. units obtained by Henri and Teves for the moment of inertia of S_2, it is found that series D corresponds to the quantum number 4 and series A, B and C to the quantum number 2. The effect of changes of pressure and of temperature on the relative intensities of the lines has been found to be large, and is still being studied. H. N. A.

2202. Resonance Broadening of Spectral Lines. J. Frenkel. *Zeits. f. Physik*, 59. 3–4. *pp.* 198–207, 1930.

Holtsmark's theory on classical mechanics of the broadening of spectral lines due to resonance is translated into the modern quantum mechanics, and is considerably extended. J. H. A.

2203. Excitation of Spectra with Hyperfine Structure. H. Schüler. *Zeits. f. Physik*, 59. 3–4. *pp.* 149–153, 1930.

Special forms of discharge tube are described which permit the investigation of the discharge in metallic vapours at the temperature of liquid air or at that of liquid hydrogen. The reduced Doppler effect at these temperatures permits a more accurate investigation of fine structure than is the case with ordinary light sources. F. S.

2204. Hyperfine Structure in Singly Ionised Thallium, Tl II. H. E. White. *Nat. Acad. Sci., Proc.* 16. *pp.* 68–71, *Jan.*, 1930.

Referring to the recent extension of the multiplet structure of singly ionised thallium made by McLennan, McLay and Crawford, the author gives an explanation of the fine structure of Tl II which is based upon his theoretical interpretation of term fine structures previously given. In the spectra considered it is confirmed that the widest fine structures are found in those terms arising from electron configurations involving a single unbalanced *s* electron. An *s* electron being found part of the time near the nucleus and part of the time outside of all of the other electrons merely acts as a "means to an end" of coupling the nuclear angular momentum **I** with the electron resultant **J**. [See also Abstract 1875 (1930).] J. J. S.

2205. Summation of Divergent Integrals in Spectral Theory. H. Eyraud. *Comptes Rendus*, 190. *pp.* 254–256, *Jan.* 27, 1930.

The author determines the Fourier spectrum of $f(t)$ which is a function of the real variable t, and obtains a formula which generalises the integral formula of Fourier. Since the structure of the spectrum of a given function depends essentially on the values which the function takes for very large values of t, the general formula $g(u;\ \mathrm{T}) = \frac{2}{\pi}\int_0^{\mathrm{T}} f(\mathrm{S}) \cos us \,.\, ds$, can only serve for very particular cases. By a suitable choice of a summation function, the spectral derivation from the above formula, *viz.*, $f(t)\Big\lfloor_{\mathrm{T}} = \int_0^{\infty} g(u;\ \mathrm{T}) \cos ut \,.\, du$, is now shown to be available. H. H. Ho.

2206. Radiations in Weak and Strong Magnetic Fields. Z. Ollano. *N. Cimento*, 8. *pp.* 13–16, *Jan.*, 1930.

In passing from a weak magnetic field to a strong magnetic field the complex division of a radiation reduces to that more simple one of the strong field according to the correlation of the atomic levels (Paschen–Back effect). As such passage takes place in a particular way for every component it is not often easy to see. The author describes a simple graphical rule which permits of distinguishing rapidly into which radiation of the strong field is going to fall every single component of the weak field.

J. J. S.

2207. Magnetophotophoresis and Electrophotophoresis. F. Ehrenhaft. *Comptes Rendus*, 190. *pp.* 263–265, *Jan.* 27, 1930.

Briefly describes observations on isolated submicroscopic particles of matter, dealing with the effects of transverse and longitudinal magnetophotophoresis and electrophotophoresis. R. C. F.

2208. Direction of the Energy Current in a Cylindrical Wave. J. Picht. *Ann. d. Physik*, 4. 2. *pp.* 273–284, *Jan.* 28, 1930.

Referring to the mathematical representation of the energy current in a cylindrical wave given in a previous paper [see Abstract 1402 (1930)], for the special case where the magnetic vector is parallel to the caustic line of the bundle of rays, the author discusses the problem further, and shows that at a sufficient distance from the caustic line, both before and behind it, in the interior of the bundle of rays, with exception of the neighbourhood of the marginal rays, the direction of the energy current coincides with that of the light rays of geometrical optics; that, on the contrary, in proximity to the marginal rays both directions diverge from each other in such a way that that of the energy current is inclined towards the axis of the pencil of rays, sometimes more, sometimes less, than that of the light rays. In the caustic surface the energy flows at all places parallel to the axis of the pencil. A drawing of the curves of equal brightness for a cylindrical wave in the neighbourhood of the caustic line is given.

J. J. S.

2209. Attempt to Detect an Electric Moment in a Light Quantum. R. J. Clark and W. H. Watson. *Cambridge Phil. Soc., Proc.* 26. *pp.* 117–121, *Jan.*, 1930.

If a light quantum has an electric moment μ, then on passing from a field free space into a region of electric field E will have its energy changed by an amount up to μE, depending on the field direction and polarisation of the light. The equivalent change in wave-length $\Delta\lambda$ equals $\frac{\mu E\lambda^2}{hc}$. The method used to detect this change was to set up a grating with a strong electric field normal to its surface and allow a plane polarised parallel beam of light to fall on the ruled surface with the electric vector parallel to the field direction (angle of incidence nearly 90°). The spectra formed near the normal to the grating were then examined (*a*) with the field on, (*b*) with the field off. If μ is sufficiently large, a splitting of the spectral lines into doublets on switching on the field should be observed. On none of the eleven plates exposed could any effect of this kind be detected. It is concluded that the upper limit to μ set by these experiments is 4.10^{-19} e.s.u. W. S. S.

2210. "Tube of Force" Theory of Light Quants and the Thermodynamics of Cavity Radiation. W. Anderson. *Zeits. f. Physik*, **59.** 9–10. *pp.* 700–717, 1930.

Further consequences of the light-quant theory put forward previously [see Abstract 1881 (1930)] are developed. A derivation of Stefan's constant gives the value $5{\cdot}771 \,.\, 10^{-5}$ against the classical theory value $5{\cdot}714 \,.\, 10^{-5}$. Experiment appears to agree better with the value $5{\cdot}771 \,.\, 10^{-5}$. The passage of one light quant through another is considered to take place accompanied by a kind of "quasifriction" varying inversely as the fifth power of the wave-length. Long-wave light quants interpenetrate without restriction, short-wave light quants behave like impenetrable solid particles. It appears that above a certain critical temperature all differences between ordinary matter and cavity radiation disappear. An estimate of the critical temperature gives a value of the order 10^{15} degrees. W. S. S.

2211. Methods for Deciding between the Corpuscular and Purely Undulatory Natures of Light and X-Rays. E. Sevin. *Comptes Rendus*, 190. *pp.* 175–176, *Jan.* 20, 1930.

Refers to the author's recent paper [see Abstract 2505 (1929)] on photoelectric effect and the continuous X-ray spectrum, in which it is shown that if X-rays of wave-length *l* act on a beam of electrons with velocity v', the latter according to the wave theory would not behave in the same way as they would if they were corpuscles, but that their energies would acquire a discreet series of magnitudes analogous to those which correspond to the different levels of electrons forming parts of atoms. Derives the following formula for the velocities of the electrons in the beam after it encounters the X-rays: $v = nh\nu'\sqrt{1 - v^2/c^2}/m_0c$, where $n = 1, 2, 3, \ldots$ and ν' is the frequency of the X-rays. If this phenomenon can be observed it will make it possible to decide in favour of the undulatory nature of the electrons. H. N. A.

2212. Method of Activating Matter. G. Reboul. *Comptes Rendus*, 189. *pp.* 1256–1257, *Dec.* 30, 1929.

The resistance cells previously described [see Abstract 3135 (1927)], which produce a very absorbable radiation, are shown to impart to bodies exposed to their action (lead, bismuth, zinc, copper, brass, iron, aluminium, carbon, and metal sheets, to which were stuck sheets of paper or cardboard) the property of affecting a photographic plate, and of discharging an electroscope; this property remains for several hours after the cell has ceased to act. A current of 1 to 2 mA with a tension of some tens of thousands of volts (in one case about 20,000 volts) passed through the cell, and this was continued from half an hour to several hours. The plates have the property of rendering gases conductors. H. N. A.

2213. Comparison of Protons and Electrons in Excitation of X-Rays by Impact. H. A. Barton. *Frank. Inst., J.* 209. *pp.* 1–19, *Jan.*, 1930.

The existence of the proton, with its mass of 1846 times that of the electron, provides the possibility of introducing a new variable—the mass—into collision experiments. Previous investigations have led to inconclusive results, except that it is known that when fast α-particles fall on an element its characteristic X-ray spectrum is excited. In the writer's experiments a mass spectrograph is used to bring either protons or electrons, of the same energy in the range from 15 kV to 25 kV, on to a copper target. The arrangement eliminates several known sources of error. X-radiation produced passed into an argon-filled Geiger counter. The procedure was to compare two currents: (1) the current composing an electron beam just intense enough to produce detectable X-rays; and (2) that composing the strongest proton beam which certainly produced less radiation. The ratio of these currents is a minimum value for ρ, the ratio of the efficiencies for excitation of electrons and protons respectively. The results were that (1) no radiation from proton impacts was observed, (2) the minimum value of ρ from three sets of experiments was 740, 237,000 and 6400. In view of the directness of the experiment the order of magnitude of the highest figure is presented as the result, *i.e.*, $\rho = 10^5$. This may be compared with $(M/m) = 1846$, $(M/m)^{3/2} = 79{,}310$, $(M/m)^2 = 3{,}408{,}000$. Wave mechanical considerations of impact processes indicate that radiation should be produced by proton impacts of energy greater than the critical energy (for copper, 8·86 kV), but intensity formulæ have not been derived. If they can be derived, the present results offer the possibility of checking the wave mechanics of impact processes. AUTHOR.

2214. Absorption in X-Ray Powder Photographs. A. Claassen. *Phil. Mag.* 9. *pp.* 57–65, *Jan.*, 1930.

Data for calculating the absorption in the powder rod, in any particular case, when making quantitative intensity measurements of X-rays from powder photographs. The integral giving the absorption-factor of the rod is evaluated graphically. The results are applied to the determination of the scattering power of tungsten. G. C. McV.

2215. X-Ray Diffraction in Organic Liquids. Part I. Cyclic Compounds. Part II. Chain Compounds. M. Ishino, S. Tanaka and A. Tsuji. *Kyoto Coll. Sci., Mem.* 13. *pp.* 1–26, *Jan.*, 1930. *In English.*

The X-ray diffraction haloes of organic liquids of a number of cyclic compounds have been investigated by the photographic method, the Shearer metal tube excited by a transformer being mostly used as a source of X-rays; the photographs are reproduced. In the production of the diffraction halo, the liquid molecules may be taken as the centres from which the X-rays are scattered, and it may be inferred that spherical molecules will produce a single sharp maximum of intensity in the halo, whereas molecules of other forms will show their characteristic intensity distribution in the halo. Although all haloes of liquid cyclic compounds have their own peculiar aspects, they are yet capable of classification into five types. Cyclic compounds without branches give sharp haloes with little scattering. The effects of various side-chains on the haloes indicate that the chemical constitutional formulæ do not generally show the real molecular form, but in certain cases parallelisms are observed between the change in the figures of the haloes and the atomic constitution of the molecules. The open-chain compounds examined include hydrocarbons, alcohols, acids and a few other compounds. The haloes of the four liquid aliphatic hydrocarbons examined show a single maximum intensity of nearly the same magnitude, whilst those of the other compounds have two maxima of different intensities characteristic of the different compounds. The size of the outer maximum is approximately constant and that of the inner one depends on the number of carbon atoms in the molecule. The sizes and distributions of the intensities in the haloes of iso-compounds are slightly different from those of the corresponding normal compounds. Unsaturated compounds show more diffuse and less clear maxima in their haloes than saturated ones. T. H. P.

2216. X-Ray Diffraction in Aqueous and Non-Aqueous Solutions. S. Tanaka and A. Tsuji. *Kyoto Coll. Sci., Mem.* 13. *pp.* 27–33, *Jan.*, 1930. *In English.*

X-ray diffraction in aqueous and non-aqueous solutions of several substances has been studied by using the CuK radiation. In the case of the aqueous solutions, the results seem to agree with the recent investigations of P. Krishnamurti, though our photographs are not so good. In the case of some non-aqueous solutions, however, quite different phenomena are observed. Dilute aqueous solutions give a pattern consisting of the outer ring due to the water, and a corona around the central spot. With increasing concentration the intensity of the corona increases gradually, and finally develops into a halo. Dilute non-aqueous solutions—benzene, ethyl ether and ethyl alcohol are the solvents—give only a fine ring of somewhat smaller diameter. With increasing concentration the diameter of the ring decreases markedly, and the inner scattering does not increase; the outer scattering, on the contrary, increases gradually, and finally it develops, in some cases, into a halo of large diameter. The solutions of camphor in benzene show it most clearly. AUTHORS.

2217. Fine Structure and Wave-Length Separation of the Kβ Doublet in the Molybdenum X-Ray Spectrum. S. K. Allison and J. H. Williams. *Phys. Rev.* 35. *pp.* 149–154, *Jan.* 15, 1930.

A nomenclature is suggested for describing the possible positions of the double X-ray spectrometer. A position may be defined by (n_A, n_B), where n_A is the order of reflection on crystal *A* and n_B the order on *B*; n_A is to be considered always positive. n_B is negative if the position of crystal B for the reflection of a wave-length incident upon it is such that by turning B through an angle of less than 90° the reflecting surface of B can be made parallel to that of A, and the given wave-length be reflected in this parallel position. If this convention be adopted, it is shown that general equations for the instrument may be easily set up. Experiments on the separation of the Kβ_1 doublet of molybdenum at the position (2, 2) at 43–46 kV and 22 mA show that if the line Kβ' reported by Davis and Purks [see Abstract 1299 (1928)] exists, its intensity is less than 1/10 that of β_1 at these voltages. An average of eight determinations of $\Delta\lambda$ for Mo*K*, $\beta_1 \beta_3$ gives $0{\cdot}572 \pm 0{\cdot}003$ XU. AUTHORS.

RADIOACTIVITY.

2218. Origin of Protoactinium. J. E. Wildish. *Am. Chem. Soc., J.* 52. *pp.* 163–177, *Jan.*, 1930.

The separation of protoactinium from carnotite was investigated. As tantalum was nearest to protoactinium, a method of quantitative separation of tantalum from different uranium ores was worked out and standardised. The uranium and protoactinium contents of five uranium ores from widely separated localities were determined, and the atom for atom relation between uranium and protoactinium was computed in each case. The results showed that the protoactinium-uranium ratio in the different ores was far from constant, and this was considered as indicating that actinium has its origin in some other source than uranium 2. F. J. B.

2219. Alleged New Disintegration Product of Radium of Short Life-Period and with Penetrating γ-Radiation. O. Erbacher and H. Käding. *Zeits. f. phys. Chem.* 6. *Abt. B.* 5. *pp.* 368–370, *Jan.*, 1930.

An experimental re-examination of the evidence from which Peters and Weil (*Naturwiss*, 17. p. 690, 1929) deduce the existence of a short-lived source of a hitherto unrecognised penetrating γ-radiation in the first disintegration product of radium. No indication of a new penetrating γ-radiation is obtained, and the observation of P. and W. is to be attributed, not to a new atomic transformation of radium, but to some secondary phenomenon. A. J. M.

2220. Radium Emanation in the Atmosphere. W. Kosmath. *Gerlands Beitr. z. Geophys.* 25. 1. *pp.* 95–117, 1930.

The amount of RaEm in the air, its vertical distribution and its dependence on meteorological conditions were investigated in Graz in the year 1928. The air dried and freed from dust was absorbed in cocoanut charcoal. The mean RaEm content 10 cm. above the surface was found to be 173×10^{-18} curie per c.c., the maximum value 335×10^{-18} and the minimum 81×10^{-18} curie per c.c. The mean concentration value, 11·5 metres above the ground, amounted to 142×10^{-18} curie per c.c., the maximum value was 270×10^{-18} and the minimum 43×10^{-18} curie per c.c. The RaEm content increases with higher air pressure and with increasing temperature and decreases with negative pressure gradients (rising air pressure). Near the earth's surface it decreases with increasing wind strength. Cloud condition and relative humidity seem to be without influence upon it. J. J. S.

2221. Ejection of α-Particles from Atom Nuclei of Radioactive Substances by Radiation of Short Wave-Length. G. I. Pokrowski. *Zeits. f. Physik*, 59. 5–6. *pp.* 427–432, 1930.

An investigation was made of the action of short-wave radiation, γ- and X-rays, on the nucleus of the radium atom. It was found that under certain conditions α-particles could be thrown out of the nucleus by the action of these rays, a phenomenon which resembles the photoelectric effect. A layer of zinc sulphide about 0·2 mm. thick mixed with a small amount of radium salt served as radioactive preparation. The activity was determined by counting the scintillations. The ZnS screen was then exposed to the action of γ-rays and X-rays from a strong Ra preparation enclosed in lead which cut off the α-particles and most of the β-particles. A distinct increase in the number of scintillations during activation was observed. The theory of the action is discussed. J. J. S.

2222. Scattering of β-Particles by Light Gases and Magnetic Moment of the Electron. M. C. Henderson. *Phil. Mag.* 8. *pp.* 847–857, *Dec.*, 1929. *Supplement.*

The hypothesis of the magnetic electron raises the question as to the effect which the magnetic field of the electron will have upon the collisions between β-particles and electrons in their orbits. Experiments upon the scattering power of light gases for β-particles were made to determine whether there is any such effect. Experiments with the β-particles from radium E show that hydrogen and helium possess a scattering power, measured between 10° and 30°, about 80 and 40 % respectively, in excess of that to be expected from the usual theory. The variation of scattering power with atomic number (N) is fitted within 8 % by the expression $a\,N^2 + kN$, where a is the relativity correction and k is 3·3 instead of the theoretical value slightly less than unity. Thus, though the electron may possess a field of force in addition to the normal electrostatic field, it appears unlikely that it can have a magnetic moment as large as one Bohr magneton. J. J. S.

2223. Passage of Fast β-Particles through Gases. E. J. Williams and F. R. Terroux. *Roy. Soc., Proc.* 126. *pp.* 289–310, *Jan.* 1, 1930.

Investigation was made by the Wilson cloud method of the primary ionisation and the frequency of production of branches for β-particles with energy ranging from about 100 to 1500 kV, corresponding to a velocity range of about 0·5 *c* to 0·97 *c*. The classical theory only gives the order of magnitude of the effects observed. The observed values are appreciably greater than the classical values and vary with the velocity according to a different law. If a magnetic moment equal to a Bohr magneton is associated with an electron, then the classical calculations for the frequency of branches give values of a different order of magnitude from those observed. The maximum magnetic moment which can be associated with an electron, regarded as a particle, is much less than a Bohr magneton. The deflection of β-particles in branch collisions corresponds approximately to the momentum of the branch. Reproductions of photographs of some of the tracks of β-particles are given. J. J. S.

2224. "Barometric Effect" of Cosmic Radiation. W. Kaufmann. *Zeits. f. Physik,* 59. 9–10. *pp.* 573–578, 1930.

The author discusses difficulties which have arisen with earlier measurements connecting the ionisation caused by cosmic radiation with barometric changes. In some tests the apparatus was insufficiently shielded from radiation from surrounding objects, emanation and its decomposition products, and charged precipitation (rain or snow). By measurements at places at different heights, for different pressures and under different weather conditions results may be obtained with a shielded portable apparatus. The scheme of working is discussed and results are to be published shortly. [See Abstract 1850 (1926).] R. S. R.

HEAT.

2225. Radiation from the Hydrogen-Oxygen Flame. W. E. Garner and K. Tawada. *Faraday Soc., Trans.* 26. *pp.* 36–45, *Jan.*, 1930.

In a previous paper one of the authors had investigated the radiation from dry carbon monoxide flame [see Abstract 3609 (1929)]. In the present paper the effect of composition, pressure, and the addition of inert gases on the radiation emitted from the flame of mixtures of hydrogen and oxygen are described. The measurements were carried out in a cylindrical bomb 2·5 cm. in diameter. The radiation was found to be at a maximum for the mixture containing 55 % of hydrogen. Drying the gaseous mixture does not affect the emission of radiation. The radiation decreases with the reduction of pressure, but more rapidly than the pressure. Inert gases show an effect on the radiation emitted which is dependent on the density of the gas. The observed phenomena are accounted for by the assumption that the radiation from this flame was thermal in character.

F. J. B.

2226. Surface Heat Flow Gauge. A. Blackie. *Journ. Sci. Instruments*, 7. *pp.* 7–14, *Jan.*, 1930.

The problem of measuring radiation and convection losses in general and the difficulties and inaccuracies involved are discussed. The principle of the surface heat flow gauge and its construction are described. The method of calibration and use in practice are given in detail and precautions necessary to avoid or minimise errors are stated. AUTHOR.

2227. Investigations by Ebullioscopic Methods. W. Swietoslawski. *Acad. Polonaise, Sci. et Lettres, Bull.* 8*a. pp.* 434–486, *Oct.*, 1929.

Is a complete account of the work done by the author and his pupils on the development and improvement of apparatus of the Beckmann type and the application to a number of physical and physical-chemical problems. Three new forms of ebullioscope are described, one of which is a differential instrument which simultaneously gives the boiling point of the solution and the solvent. The author draws attention to the fact that during the course of an experiment the barometric pressure may vary and that the barometer may not respond to such variations rapidly enough. He, therefore, adapts one of his instruments and calibrates it so as to record atmospheric variations in terms of the ebullioscope. This ebullioscopic barometer may also be utilised to measure the pressure of a gas in an enclosed space. In the normal use of the ebullioscope, two instruments are required, one for the solution and the other for the solvent; or, alternatively, the differential instrument may be utilised. The author shows how his instrument may be used for the standardisation and calibration of thermometers of the Beckmann type and experiments on Raoult's law. Investigations on the boiling point and vapour pressure of mixed liquids can be carried out; also the variation of the coefficient of solubility of a solid substance with temperature. The applications to static and kinetic chemistry include the determination of the equilibrium constant of reaction in the liquid and in the gaseous phase; also the determination of the velocity constant of chemical reaction. Finally, an account is given of an apparatus for making measurements at high pressures (30 atmospheres). W. C. S. P.

2228. Effect of Small Changes in Temperature on the Properties of Bodies. M. D. Hersey. *Bureau of Standards, J. of Research,* 4. *pp.* 137–156, *Jan.,* 1930.

When it is found necessary to determine the effect of small departures from normal temperature upon some property of a body or system of bodies, such as the stiffness of a steel spring, the vibration frequency of a tuning fork, or the accuracy of an instrument, it is usually done either (*a*) by a detailed computation or (*b*) by a direct experiment in which the temperature is actually varied. After reviewing and illustrating the usual methods of solution a general mathematical treatment of the problem is given, from which two additional methods are derived that can sometimes be usefully applied: (*a*) A simple calculation, made possible by the theory of dimensions, which does not require any detailed formula for the property in question; and (*b*) a combined theoretical and experimental solution, in which the experimental factors have been reduced to a minimum and can be determined without varying the temperature of the body itself, provided the thermal properties of the component materials are known. Finally, it is pointed out that the same treatment can be extended to any other condition analogous to temperature, such as hydrostatic pressure. AUTHOR.

2229. Melting Point Curves for Hydrogen, Neon, Nitrogen and Argon. F. Simon, M. Ruhemann and W. A. M. Edwards. *Zeits. f. phys. Chem.* 6. *Abt. B.* 5. *pp.* 331–342, *Jan.;* and 7. *Abt. B. p.* 80, *March,* 1930.

The results obtained for these four gases are tabulated and show the melting point at pressures up to slightly above 5000 kg./cm.^{2} for hydrogen and nitrogen, to 4900 kg./cm.^{2} for neon and to 3400 kg./cm.^{2} for argon. From these values and using the Clausius-Clapeyron equation the density in the solid phase at the melting point is obtained for H, N and A. For all four substances the equation $\log (p + a) = c \log T + b$ is satisfied, where p and T are the corresponding pressures and temperatures and a, b and c are constants. The deviations are throughout within the limits of experimental error. The values of a, b and c are tabulated. The values obtained for hydrogen agree well with those by Keesom, and differences are ascribed to different molecular forms of hydrogen. It is confirmed that a close connection exists between a and the internal molecular attraction [see Abstract 1516 (1930)]. R. S. R.

2230. Rock Glass and the Solid and Liquid States. L. Hawkes. *Geolog. Mag.* 67. *pp.* 17–24, *Jan.,* 1930.

The author discusses the definitions of the terms " solid " and " liquid " and shows that these two states are best defined on the basis of the viscosity-temperature curve. Glasses are amorphous solids. Their state of molecular aggregation is fundamentally different from that of liquids; they are not supercooled liquids. It is suggested that porphyritic texture may result from an even rate of magmatic cooling on account of the abnormal increase in viscosity which occurs before vitrificaction.

W. C. S. P.

2231. Temperatures in the Electric Arc Measured by Means of the Band Spectrum. L. S. Ornstein and W. R. van Wijk. *K. Akad. Amsterdam, Proc.* 33. 1. *pp.* 44–46, 1930. *In German.*

If it is assumed that the band spectra emitted by an arc indicate the rotational states that correspond to the actual temperatures of the gas at the places of emission, measurements of the intensity of the lines of the bands will enable the corresponding temperatures to be calculated. An attempt is made to measure the temperature in both the inner and outer layers of an electric arc produced between an aluminium pole as kathode and a carbon as anode. This arc consists of a violet core (cyanogen bands) surrounded by a green envelope (AlO bands). Graphs are drawn with $\log(Ip(n)/n)$ as ordinate and $n(n + 1)$ as abscissa, where I is the intensity of the line; and approximately straight lines are obtained both for CN and AlO. If T is the absolute temperature, J the moment of inertia of the molecule, k the Boltzmann constant, $\log(Ip(n)/n)$ is proportional to $-h^2 . n(n - 1)/8\pi^2 JkT$. The maximum temperatures derived from the graphs are 5000° Abs. for CN and 2800° Abs. for AlO. T. B.

2232. Platinum Contamination of Palladium in Palladium Point Determinations. C. L. Utterback. *Rev. Sci, Instruments*, 1. *pp.* 39–44, *Jan.*, 1930.

Palladium in contact with platinum has been heated to the melting point starting with different initial temperatures. Different methods of contact and different times of heating were used. Spectrographic, photomicrographic and chemical analyses show definite contamination which increases with both temperature and time. Palladium point determinations indicate that this contamination may account for inconsistent results observed in the melting point. AUTHOR.

2233. Temperature Variation of the Specific Heats of Hydrogen and Nitrogen. J. H. Brinkworth. *Roy. Soc., Proc.* 126. *pp.* 204–212, *Jan.* 1, 1930.

The energy of a gramme-molecule of an ideal gas can be calculated from the kinetic theory. By application of the Maxwell-Boltzmann hypothesis the molecular specific heats at constant volume (S_v) are deduced in the case of ideal monatomic and diatomic gases to be 3R/2 and 5R/2 respectively at all temperatures. (R is the gas constant per gramme-molecule; R = 1·985 gm. cal./°C.) The corresponding molecular specific heats at constant pressure (S_p) can be obtained by addition of R. In the case of real gases, which obey some form of characteristic equation other than PV = RT, it can be shown from thermodynamical considerations that the value of S_p is not independent of the temperature, but increases in value as the temperature is reduced. Experimental measurements of the specific heats of monatomic gases show that S_p and S_v are independent of temperature, and, therefore, for monatomic gases S_p and S_v may be taken to be 3R/2 and 5R/2 except at very low temperatures when the effect of the thermodynamical correction term must be regarded. Experiments on diatomic gases at high temperatures show that the specific heats increase fairly rapidly with the temperature. Tabulated values, both experimental and theoretical, are given for the specific heats of nitrogen and are found to be in excellent agreement. Experiments with hydrogen indicate a rather more rapid increase in the values of the specific heats with temperature at high temperatures than is found in the case of nitrogen, but there is good experimental evidence of the rapid decrease in their values at temperatures below 300° Abs. The specific heats of hydrogen due to Newitt are given as:

Temperature Range ..	18°–2150° C.	18°–2500° C.	18°–2600° C.
Mean Specific Heat ..	5·89	6·14	6·16

The paper concludes with a theoretical development and a suggestion of a new formula for the total specific heat. The moments of inertia of the molecules of hydrogen and nitrogen are deduced and given as: moment of inertia of hydrogen molecule $4 \cdot 4 \times 10^{-41}$ gm. cm.^{2} and of nitrogen molecule 16×10^{-40} gm. cm.^{2} This value is a minimum estimate.

S. G. B.

2234. Flow Method for Comparing the Specific Heats of Gases. Part I. Experimental Method. P. M. S. Blackett, P. S. H. Henry and E. K. Rideal. Part II. Theory of Method. P. M. S. Blackett and P. S. H. Henry. *Roy. Soc., Proc.* 126. *pp.* 319–354, *Jan.* 1, 1930.

Part I. The method enables the ratio of the specific heats of two gases to be measured accurately, by giving relative values taking the monatomic gases as standards. It consists essentially in passing a slow stream of gas through a narrow tube along which a temperature gradient has been established. The change of temperature distribution along the tube depends on the properties of the gas and the rate of flow. It is found possible to choose the arrangement so that the measured temperature difference between two parts of the tube is a direct measure of the specific heat of the gas flowing in it. The heat losses in this method, differing from other "constant flow" methods, whilst playing an essential part in the theory of the apparatus, do not enter at all into the measurement of the specific heat, and secondly it is never required to measure the exact temperature of the gas under investigation, but instead the temperature of the tube containing the gas is measured without disturbing the flow. Full experimental details are given, as well as a typical set of readings. The results are in remarkable agreement with the best-known values. The relative values of the specific heats of carbon dioxide, hydrogen, air and helium are given, experiments with CO_2 and H_2 having been carried out with a range of central temperature of as much as 28° C. Typical values found were: $\frac{C_p\text{Helium}}{C_p\text{Air}}$ = Mean value from experiment, 0·717, Partington and Schilling's value, 0·716.

In Part II the theory of the heat transfer between a tube along which a temperature distribution exists and a gas is flowing is developed. The result is expressed in the form of a general equation applicable to any form of this apparatus. The theory is then applied to a symmetrically electrically-heated tube as a special case. The good agreement obtained between theory and experiment is regarded as supporting the validity of the work and the theoretical treatment.

S. G. B.

2235. Specific Heats of Gases at High Pressures. N. W. Krase and B. H. Mackey. *Am. Chem. Soc., J.* 52. *pp.* 108–115, *Jan.*, 1930.

This is the first of a promised series of papers on the measurement of specific heats of gases at high pressures. It describes a continuous flow, adiabatic gas calorimeter designed to measure the specific heat of a gas up to 1000 atmospheres at ordinary temperature, as the literature contains practically no data of this property on gases above 200 atmospheres. The apparatus described and illustrated in diagrams differs from previous ones of the same general character in the methods of measuring the various heat loss corrections. The heat of stirring and the losses due to radiation, convection, evaporation, etc., are determined by making measurements with no gas flowing, but with all other conditions exactly as in a regular experiment. Typical results for nitrogen at 200 atmospheres are given together with the method of calculation. A discussion of the probable errors of measurement follows, and it is estimated that the results are reproducible to 0·5 %. T. B.

2236. Friction, Heat Conductivity, and Diffusion in Gas Mixtures. M. Trautz. *Ann. d. Physik*, 3. 8. *pp.* 1102–1118, *Dec.* 23, 1929.

The paper deals with the treatment of gas friction and gas reaction on parallel lines. Thermodynamically and by their characteristic phenomena the two are compared. Under the treatment given it is shown that from geometrical investigation the basis for the development of Nernst's heat law space conditions can be deduced for the relationship of the kinetic quantity η. From the treatment of the constants, the temperature independence factor of the dimension T leads to the postulation of a characteristic temperature. The various functions and meanings of the relationships of this characteristic temperature θ to the molar weight M are developed, and, finally, the product of $\sqrt[3]{M}$ and $\sqrt[4]{\theta}$ is worked out and discussed for a variety of gases. Its constancy for the heavier molecules is remarkable whether they are monatomic or otherwise. A (3·11), Kr (3·11), Xe (3·09), and HCl (3·06), Br_2 (3·05), SO_2 (3·01) follow close upon each other. The lighter molecules such as H and those containing hydrogen to a large degree, such as C_2H_4, as also N_2 and CO, vary from the rule on the low side, whilst He and Ne are on the high side. (He, 3·13; Ne, 3·29; H_2, 2·66; etc.) The consequences of this result are related to Nernst's expression for gas degeneration and an equivalent for characteristic temperature is deduced. S. G. B.

2237. Pressure of Gaseous Mixtures. Part III. C. C. Tanner and I. Masson. *Roy. Soc., Proc.* 126. *pp.* 268–288, *Jan.* 1, 1930.

The case of He and H, dealt with in Part II (see Abstract 1923 (1929)], was rather a special one, as both gases deviate positively from Boyle's law, both kinds of molecule are light, small and hard, and other pairs of gases might behave differently. The authors have now studied mixtures of each of these gases with argon, which deviates from Boyle's law negatively between 25° and 75° C. Above 100° C. the deviations are positive. The results are shown for argon-helium mixtures in a four-dimensional diagram; this contains the isometric projections of three solid models, each corresponding with a fixed temperature: 25°, 100° and 175°. In each of these, on the vertical axis, are measured the plus and minus deviations of pv from Boyle's law, on one of the horizontal axes are marked the percentage composition of the mixtures, and on the horizontal axis at right angles to this the pressures. Dotted contour lines of equal deviation from Boyle's law are marked on the surface which represents the properties of the mixture. The behaviour is considered of the virial coefficients for the different mixtures in connection with the partial pressure law. The Lennard-Jones equations for intermolecular action are applied to the data for the temperature variations of b_{11}, b_{22}, and b_{12}. In all cases the exponent of the attractive component m is assumed equal to 5, and the effect of assuming different values 9, 10, 11 and $14\frac{1}{3}$ for n, the exponent of the repulsive component, is tried; the results are given in a table. No obvious relationship was found between the force constants λ of two pure gases, on the one hand, and those of their mixtures on the other. Calculations of the kinetic diameters make it clear that the radius of a gaseous molecule in collision is a function of the kinetic energy of the invading molecule, and depends on its nature. H. N. A.

2238. Relationship between Gas Pressure and the Translatory Energy of the Gas Molecule. K. Schaposchnikow. *Zeits. f. Physik,* 59. 9–10. *pp.* 725–726, 1930.

Exception is taken to the statement of Anderson [see Abstract 1127 (1930)] that the conclusions of the author in a previous paper are not valid. On the ground of a mechanical light-quantum theory Fedoroff and the author and others came to the conclusion that the energy of a light quantum is made up of two equal parts, *i.e.*, a kinetic energy of translatory motion, and another of rotational energy. The whole argument turns on the statements: $E_{\text{trans.}} = E$, and $p = 1/3E$. The author shows that the latter expression is definitely deducible from his results, and establishes the formula directly from his previous argument. S. G. B.

2239. Equation of State of an Ionised Gas. W. H. McCrea. *Cambridge Phil. Soc., Proc.* 26. *pp.* 107–114, *Jan.*, 1930.

The equation of state of an ionised gas is of importance in astrophysical applications. The only form of it considered in the paper is to find the pressure in a gas of given temperature in which the number of atoms in unit volume at the different possible stages of ionisation are supposed known. In the usual treatment each independent system (atom, ion or electron) contributes $3/2 \times kT$ to the dynamic part of the pressure, k being the gas constant. The "electrostatic correction" is then calculated. In the present note it is shown to be legitimate to treat an atom or ion consisting of several particles as one single particle in computing its contribution to the dynamical pressure. It is also shown that there is a "dynamical correction" for free-charged particles in addition to the electrostatic correction. These corrections are of opposite sign, and on the average the present correction reduces the electrostatic correction by about one-half. It is thus concluded that the deviations from perfect gas laws in stellar material may perhaps be too small to give any observable effects. T. B.

2240. New Equation of State for Fluids. Part IV. J. A. Beattie. *Nat. Acad. Sci., Proc.* 16. *pp.* 14–19, *Jan.*, 1930.

Equations of state have almost universally been of such a form that they can be solved explicitly for the pressure, but not for the volume [see Abstract 1247 (1929)]. It is now shown that by the use of a single set of equations of state constants, together with thermal data on pure gases, it is possible to give equations which lead to a numerical solution for the thermodynamic properties of real gases and their mixtures in terms of either set of the independent variables V, T or p, T. Some equations have a simpler form in terms of one set of variables, and others in the other set. The experimental data, however, are usually given in terms of the independent variables p and T. H. H. Ho.

2241. Thermodynamics of an Elastic Solid. H. Jeffreys. *Cambridge Phil. Soc., Proc.* 26. *pp.* 101–106. *Jan.*, 1930.

A mathematical discussion of the problem dealing amongst other things with the relationships of heat conduction, specific heat, etc., and special applications to the earth's crust and iron. S. G. B.

SOUND.

2242. Acoustics of Rooms. J. Zenneck. *Tijds. Nederland Radiogenootschap*, 14. *pp.* 71–79, *Dec.*, 1929.

Investigation, with the aid of oscillograms, of the acoustic properties of various rooms and halls. Discussion of observations. A. D.

2243. Hearing. R. T. Beatty. *Wireless World and Radio Rev.* 25. *pp.* 649–652, *Dec.* 11, *and pp.* 677–681, *Dec.* 18, 1929.

A clear account, in non-technical language, of the structure of the ear and its functions. Experiments on guinea-pigs, on the effect of loud sounds continued for some hours, showed that local degeneration of the basilar membrane was caused at different regions by notes of different pitch. Notes of low pitch affected the portion of the membrane towards the apex of the cochlea where the fibres are long. The guinea-pig responds to any note within its range of hearing by a tremor of its ear-muscle. In certain experiments carried out at Leipzig, a guinea-pig responded in this way to all the notes of a series of tuning forks spaced a semitone apart from 1000 to 40,000 cycles per second. Some threads of the ligament which holds the membrane taut were then broken by means of a very fine drill. The animal was thereby rendered deaf over a frequency band not exceeding a single tone. The position of the deaf region varied with that of the drilled hole in the same sense as in the previous experiment, and the narrow deafness bands disappeared after three weeks. The experiments uphold the resonance theory of hearing, and arguments based on a knowledge of nerve action are quite opposed to the telephone theory of hearing. Other points discussed are the production of overtones by the ear itself, difference tones and their assistance in the transmission of sounds of low frequency by loud-speakers which fail to reproduce below 250 cycles per sec. The ear as a rectifier is compared with the anode bend rectifier in wireless. On the question whether beats merge into difference tones, the author gives reasons for concluding that beats and difference tones are entirely different. The articles, which are copiously illustrated, conclude with a discussion of perception of direction of sound and the evolution of the organ of hearing. G. E. A.

2244. Sound Reception by the Outer Ear. J. Tröger. *Phys. Zeits.* 31. *pp.* 26–47, *Jan.* 1., 1930.

Gives theory and experiment of an acoustical method, analogous to the Lecher wire method for electric waves, by which the frequency-response characteristics of the ear-drum can be measured. W. H. Ge.

2245. Theory of Vibration of the Larynx. R. L. Wegel. *Bell System Techn. J.* 9. *pp.* 207–227, *Jan.*, 1930.

A simplified model of the larynx is considered, for which energy equations are found. These give force equations for the glottis and vocal chords from which a determinant is obtained which represents the complete reactions of the larynx and the external effects of communicating air chambers. The voice system represented by the determinant is closely analogous to that of a tuned-grid oscillator, and the solution gives the condition for sustained oscillation, as in singing, or for subsidence or accretion of the oscillation, as in speaking. G. E. A.

2246. Resonance of Pipes with a Movable End. K. Sato. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 56. *pp.* 49–92, *Jan.*, 1930. *In English.*

The sources employed were organ pipes of respective pitches c_1, c_2, c_3 and c_4, blown with uniform pressure at a distance of 2 m. from the pipes under test. The detecting apparatus was a Rayleigh disc placed within the mouth of the pipe. The pipes tested were (1) a straight pipe with uniform circular section, (2) a bent pipe with uniform circular section, (3) a straight pipe with a neck, and (4) a pipe connected with a conical horn at its neck. The length of the pipe was varied by means of a piston, and the variation of intensity of the forced vibration, as measured by the deflection of the disc, is graphed as a function of the length of the pipe. In all cases the experimental results agree closely with those expected from theory. G. E. A.

2247. End Correction and Conductance at the Mouth of a Stopped Organ (Flue) Pipe. A. E. Bate. *Phil. Mag.* 9. *pp.* 23–28, *Jan.*, 1930.

A stopped organ pipe behaves in exactly the same way as a cylindrical resonator without a neck, provided that the edge-tone set up by the vortex system in the air-stream at the mouth of the pipe synchronises with the natural frequency of the air-column in the pipe. It follows that the usual resonator formulæ may be applied, and from these the equation $A = c . a$ is deduced, and is shown to hold experimentally, if c is regarded as being somewhat larger than the equivalent diameter of the orifice. AUTHOR.

2248. Wind Instruments From Musical and Scientific Aspects. E. G. Richardson. *Roy. Soc. Arts, J.* 78. *pp.* 203–214, *Jan.* 3; 224–236, *Jan.* 10, and *pp.* 258–269, *Jan.* 17, 1930. *Cantor Lectures.*

The first lecture deals with the evolution of wind instruments from the earliest to modern times and is well illustrated with drawings. In the second and third lectures some of the scientific principles involved are discussed, *e.g.*, the modes of excitation and maintenance of the vibrations of a column of air; the functions of the mouthpieces. Some additional information can be obtained from the same author's book, *The Acoustics of Orchestral Instruments and of the Organ.* London, 1929. W. H. GE.

2249. Generation of Pulses in Vibrating Strings. D. Banerji and R. Ganguli. *Phil. Mag.* 9. *pp.* 88–92, *Jan.*, 1930.

A problem suggested by one method of playing an Indian musical instrument, a vina, in which a sudden increase is made in the length of a stopped vibrating string. A mechanical scissor-like clamp is used in the laboratory, and photographic records of a point of the vibrating string are made when the clamp placed at important nodes is suddenly opened. W. H. GE.

2250. Scientific Analysis of Musical Sounds. J. F. Cellerier. *Comptes Rendus*, 190. *pp.* 45–47, *Jan.* 6, 1930.

The method here described is based on the transformation of acoustic phenomena into electric oscillations, whose characteristics are then determined. The microphone employed utilises a piezoelectric quartz disc on whose two faces metal electrodes are mounted. This is arranged in a suitable electric circuit and gives rise to induced currents of the same periods and whose intensities are proportional, at any instant, to the components of the sound incident on the microphone. The harmonics are selected by suitable filters, preceded and followed by amplifiers. The method of standardisation is described, and typical results are illustrated. Measurements of the intensities of the harmonics in the sound of a motor horn showed that some of the higher harmonics were considerably stronger than the fundamental, thus accounting for the strident quality of the sound emitted. A. W.

2251. Range-Finding. F. Morley and H. A. Robinson. *Nat. Acad. Sci., Proc.* 16. *pp.* 74–77, *Jan.*, 1930.

A note on the theory of the location of an object, such as a gun, by timing a sound or other vibration of known velocity at three, four or five different stations in a plane or on a sphere. W. H. Ge.

2252. Transmission of Sound Energy and Thickness of Plate Transmitter at Normal Incidence—Ultrasonic Method. R. W. Boyle and D. O. Sproule. *Canad. J. of Research*, 2. *pp.* 3–12, *Jan.*, 1930.

Another and more direct experimental method for determining the reflection from and transmission through parallel-faced partitions of sound energy of short wave-length was studied. Measurements were taken of the energy transmitted through obstructing plates by means of a torsion pendulum placed in the " ultrasonic shadow," the incidence of the energy being normal. The theoretical and experimental results obtained in previous researches by taking reflection measurements only were confirmed, and again it was shown necessary to employ the bulk modulus of elasticity for computations of velocity instead of Young's. [See also Abstract 1943 (1930).] Authors.

2253. Supersonic Cavitation. G. B. Taylor and D. O. Sproule. *Roy. Soc. Canada, Trans.* 23. *Sect.* 3. *pp.* 91–93, *Jan.*, 1929.

A bell-jar 25 cm. high was cemented to the face of a supersonic transmitter of the double steel-plate, quartz-block type, of which the face was horizontal. The jar was nearly filled with water. On actuating the transmitter at its resonant frequency of 45,000 cycles per sec. no unusual effects were observed until the pressure in the jar had been reduced to about 20 cm. of mercury. At this stage numerous fine bubbles were seen in the body of the liquid. These increased in size and number as the pressure was further reduced and showed a tendency for some time to remain suspended in nodal layers, but eventually to rise step by step to the free surface. The formation of layers of bubbles half a wave-length apart was much more marked at higher frequencies of 309,000 and 172,500 cycles per sec. The critical pressure at which bubbles just occurred was found to increase with the applied potential. It was found possible to throw the whole column of water into resonance when the height of the free surface above the transmitter face was equal to an odd number of quarter wave-lengths. Use was made of this to measure the velocity of sound in water. The velocity was found to vary slightly with the degree of aeration of the water. For ordinary tap water the velocity was found to be $1{\cdot}48 \times 10^5$ cm. per sec. when first placed in the apparatus, but after de-aeration by cavitation under reduced pressure at frequent intervals over a period of two days the velocity was found to be slightly higher, $1{\cdot}52 \times 10^5$ cm. per sec. A. W.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

2254. Electric Charge on Rain. Thora C. Marwick. *Roy. Meteorolog. Soc., J.* 56. *pp.* 39–44, *Jan.*, 1930.

Observations were made at Otago, New Zealand, in the winter and early spring, 1922. The rain was collected in a tilting-bucket type of gauge and the sign and magnitude of the charge found for different types of rain. Errors due to splashing and the Lenard effect were carefully reduced. The percentage of positive charge for different types of rain were: (1) thunderstorm rain 94·6, (2) ordinary rain 79·5, (3) drizzle 100, and (4) hail and rain 39·4. For snow equal amounts of positive and negative were found, but the charge per cc. is much greater for the positive samples. For thunderstorms the greatest changes of atmosphere potential and the highest charges occur at the beginning of the storm. From the total charge the percentage of positive is 65·5 for all four types of rain and 89·5 if occasions with hail and sleet are omitted. R. S. R.

2255. Formula for Mean Lattice Potential. J. Frenkel. *Zeits. f. Physik*, 59. 9–10. *pp.* 649–650, 1930.

Bethe has given a formula for the mean lattice potential [see Abstract 932 (1929)]. It is pointed out that the same formula was derived by the present author many years ago [see Abstract 543 (1917)] from consideration of the electric double layer of atomic dimensions at the surface of solids and liquids. Various applications of the formula have been given in subsequent papers. [See also Abstracts 3181 (1928) and 964 (1929).] A. W.

2256. Determination of Contact Potentials. E. Patai. *Zeits. f. Physik*, 59. 9–10. *pp.* 697–699, 1930.

The method consists in determining the characteristic of a three-electrode valve (*a*) with the grid, consisting of a given metal, thoroughly outgassed, (*b*) with the same grid on which a layer of sodium has been deposited by introducing sodium into the tube electrolytically. The displacement of the characteristic curve parallel to the axis of grid volts gives the contact potential difference between sodium and the metal composing the grid. The result for molybdenum and sodium agrees approximately with that deduced from the work functions of these two metals. W. S. S.

2257. Variation of Dielectric Constants of Organic Liquids with Frequency in the Range 1 to 10^3 Kilocycles. R. W. Lunt and M. A. G. Rau. *Roy. Soc., Proc.* 126. *pp.* 213–230, *Jan.* 1, 1930.

The dielectric constants of benzene, ether, methylated ether, chloroform, ethyl alcohol, acetone, aniline and nitrobenzene, and also the conductivities of the four last mentioned substances, have been determined within the frequency range 1 to 10^3 kc. Full experimental details are included. No variation of the constant has been observed for benzene. ether and chloroform, whilst for the remaining liquids a slight increase takes place in the range 10^2 to 10^3 kc. In this range the conductivity of aniline diminishes rapidly as the frequency is increased, that of nitrobenzene diminishes slightly, whilst that of ethyl alcohol and of acetone does not vary. H. H. Ho.

2258. Dielectric Properties of Ionised Gases and the High-Frequency Discharge. H. Gutton. *Ann. de Physique*, 13. *pp.* 62–129, *Jan.*, 1930.

The paper gives a detailed account of experiments on the above subject, the principal results of which have already been reported [see Abstract 3159 (1929).] W. S. S.

2259. Electric Moments in Homologous Series. H. A. Stuart. *Phys. Zeits.* 31. *pp.* 80–83, *Jan.* 15, 1930.

It is shown how the variation of electric moments in certain homologous series may be explained by the polarisation of CH_2- and CH_3-groups through characteristic linkage moments, when the free rotatability is considered as restricted by definite states of minimum potential energy. The molecular formulæ of certain ethers, nitriles and propyl chloride are discussed. H. H. Ho.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

2260. Electrical Conductivity of Fused Silicon. F. Lauster. *Zeits. f. Physik*, 59. 1–2. *pp.* 83–90, 1929.

According to Koenigsberger and Schilling, the specific resistance of fused silicon decreases with rise in temperature, but undergoes sudden changes in value at certain critical temperatures. The present author has carried out exact investigations on three different specimens of fused silicon, one of which was melted *in vacuo*. Sudden changes in resistance were observed in the case of the normal fused silicon, but the results are not in general agreement with those of Koenigsberger and Schilling. The specific resistance of the vacuum fused silicon is 0·07 ohm per cm. cube. The results do not confirm the view of regarding fused silicon as a semiconductor. W. C. S. P.

2261. Dual Theory of Metallic Conduction. E. H. Hall. *Nat. Acad. Sci., Proc.* 16. *pp.* 45–55, *Jan.*, 1930.

This paper is a revision of the author's " Summary " [see Abstract 1934 (1921)] of the numerical results tentatively arrived at by means of the dual theory of conduction, especially the values of the " characteristic constants " of the various metals dealt with. In the revision of these numerical estimates some new data furnished by the International Critical Tables have been utilised. A complete statement of all the features and applications of the dual theory in its present state of development is not given, but the paper shows what measure of success this theory has attained in dealing numerically with the relations between electrical conduction, thermal conduction, the Thomson effect and the Peltier effect in eighteen metals, including two alloys. J. J. S.

2262. Theories of Electrical and Thermal Conductivity of Metals. R. Peierls. *Ann. d. Physik*, 4. 2. *pp.* 121–148, *Jan.* 28, 1930.

Some simplifying assumptions of the hitherto accepted conductivity theories are discussed and shown to be inadmissible. A stricter analysis—a modification of that of Bloch—is given, and it is shown that the results for temperature relation and order of magnitude of the electrical conductivity at high temperatures can be regained unchanged, the latter, however, only in quite rough valuation. For low temperatures proportionality of the conductivity to T^{-4} is found, in agreement with the empirical law. The same methods when applied to the calculation of the thermal conductivity yield the right order of magnitude. In the limiting case of low temperatures proportionality of the thermal conductivity to T^{-2} was obtained, for high temperatures independence of temperature in agreement with experiment. J. J. S.

2263. Electrical Conductivity of Sputtered Metal Films. E. Perucca. *Ann. d. Physik*, 4. 2. *pp.* 252–272, *Jan.* 28, 1930. *N. Cimento*, 7. *pp.* 50–68, *Feb.*, 1930.

Electrical measurements were made on films of gold and of platinum having very high resistance. They show considerable stability. Ohm's law is obeyed, and there is no trace of counter e.m.f. The temperature coefficient is abnormal; for platinum on glass or quartz, the coefficient is more than 1 % per 1° C., whereas for gold it is much smaller. The probable structure of the films is discussed in the light of the observations. J. H. A.

2264. Electrical Resistance of Thin Metal Films. W. Braunbek. *Zeits. f. Physik*, 59. 3–4. *pp.* 191–197, 1930.

The observations of Volmer and Estermann, taken for other purposes, are utilised to investigate the dependence of specific resistance on thickness in the case of films of solid mercury. A curve of the usual type is found, exhibiting an abnormally high resistance for the thinnest films. Even for the thickest films for which data are available the resistance is about three times that of mercury in bulk at the same temperature. J. H. A.

2265. Temperature Variation of Electrical Resistance at Low Temperatures. F. Block. *Zeits. f. Physik*, 59. 3–4. *pp.* 208–214, 1930.

The paper is entirely theoretical. At temperatures low compared with the characteristic temperature of the metal it is concluded that the resistance should vary as the fifth power of the absolute temperature. J. H. A.

2266. Measurement of Weak Alternating Currents by Means of Tellurium-Platinum Thermoelements. H. Teichmann. *Zeits. f. Physik*, 59. 9–10. *pp.* 615–622, 1930.

A description is given of the structure and use of tellurium-platinum thermoelements. Details are given of a highly sensitive arrangement for the measurement of weak alternating currents. In this tellurium-platinum thermoelements are placed in the arms of a Wheatstone bridge. Accurate measurements were obtained of alternating currents between 0·0001 and 0·01 A. J. J. S.

2267. Measurement of the Thermoelectric Force per Degree of Pure Metals and Alloys down to the Temperature of Liquid Hydrogen, and Calculation of the Thomson Effect. G. Borelius, W. H. Keesom, C. H. Johansson and J. O. Linde. *K. Akad. Amsterdam, Proc.* 33. 1. *pp.* 17–43, 1930. *Comm. Nos.* 206*a and* 206*b from the Phys. Lab., Leiden.*

In a previous paper [see Abstract 1974 (1929)] results were given of measurements of the Thomson effect (σ) in two metal wires, one Ag and one Cu, both alloyed with some gold, down to the temperature of liquid hydrogen. These wires are now used as " normals " for indirect determinations of σ in a number of pure metals (*Comm.* 206*a*) and alloys (*Comm.* 206*b*). The Thomson effect is calculated from the equation $\sigma = \sigma_{\text{norm.}} + T \, . \, de/dT$, where e is the thermoelectric force per degree against the normal wire with a known Thomson effect ($\sigma_{\text{norm.}}$) and T is the absolute temperature. The pure metals investigated are Cu, Ag, Au, Fe, Pd, Pt, Pb, Ni and Co, all with cubic structure; and Zn and Cd, hexagonally crystallising metals; and the alloys include binary alloys of Cu, with small quantities of Fe, Co, Ni, Pd, As and Au; binary alloys of Pt and Rh; and a ternary Pt, Pd, Au alloy. It is concluded that in general there is a tendency towards verification of the limiting laws $\sigma \rightarrow 0$ and $e \rightarrow 0$ for $T \rightarrow 0$, but that experiments at still lower temperatures will be necessary to obtain conclusive results. T. B

2268. Optical Observation of Langmuir Probes. R. Seeliger and H. Straehler. *Phys. Zeits.* 30. *pp.* 929–932, *Dec.* 15, 1929.

The conversion of a Langmuir probe into a glow-discharge kathode may be optically followed by increasing the negative potential applied to it while maintaining the gas density and the current constant. A suitable choice of gas is pure helium, or neon with a little hydrogen or mercury. [See also Abstract 1576 (1930).] E. E. F. d'A.

2269. Glow Discharge with Hollow Kathode. A. Güntherschulze. *Zeits. f. techn. Physik*, 11. 2. *pp.* 49–54, 1930.

Using a kathode consisting of two concentric cylinders with their ends a small distance apart and a cylindrical anode surrounding the gap between the two halves of the kathode, a marked increase of the current density of the glow discharge is obtained with suitable gap width and gas pressure. An investigation was made of this effect and its dependence on pressure and gap width for H, N, O, He, Ne and A. The results show that the increase of the glow current, or amplification factor, rises rapidly with decreased pressure and increased kathode fall of potential. With a 10 mm. gap width the increase for neon with only 290 volts kathode fall is too great to be measured. For He the increase is several hundred times and for H up to eighty times. Forty-fold increases were observed with O and N. With argon irregular effects were obtained. At low gas pressures two stable types of discharge were observed, one being characterised by high current density and the other, which is obtained with relatively high kathode fall of potential, by low current density and lack of sharpness in the boundary of the dark space. A. W.

2270. Glow Discharge. A. Güntherschulze. *Zeits. f. techn. Physik*, 11. 3. *pp.* 76–78, 1930.

The phenomenon observed by Steenbeck [see Abstract 1563 (1930)], that in the development of the glow discharge in the region of anomalous kathode fall of potential the current reaches a value in excess of its final value, is here explained as being due to the existence of an excess temperature in the kathode fall space. A. W.

2271. Kathode Fall of Glow Discharge in Relation to Current Density, at Voltages up to 3000V. A. Güntherschulze. *Zeits. f. Physik*, 59. 7–8. *pp.* 433–445, 1930.

The experiments described were made with low gas pressures, down to 0·006 mm., in a vessel containing 54 litres, and kathode and anode each of 1250 cm^2 surface; kathodes of iron (heavy), and of an aluminium magnesium alloy, were employed. The following relation was found to hold between current density j, kathode fall V and gas pressure p : $j = C_3 . p^2 V c_1$, very closely for H_2, O_2 and N_2, less closely for He, in a limited range for Ne, and not at all for A. If a glow discharge takes place without secondary disturbances due to multiple collisions, resonance radiations or high temperatures, considerations of geometrical similarity demand, with constant kathode fall, that the relation $j = Cp^2$ should hold. This is not the case for high pressures, which shows that then disturbances take place. In the actual experiments on the other hand it appears that for the first named gases there were no such disturbances. The relation $p \cdot d =$ const., where d is the length of the fall space, was found to hold for O_2 and N_2, and approximately for H_2, but not for the other gases; this relation follows from the similarity law. H. N. A.

2272. Glow in Side Branch of a Discharge Tube Containing Argon. Ira M. Freeman. *Zeits. f. Physik*, 59. 9–10. *pp.* 635–637, 1930.

The glow which appears in the side branch of a discharge tube containing argon has been studied spectroscopically. The spectrum contains lines of both the " blue " and " red " spectra and is very similar to what has been called the " white " spectrum. From a consideration of the intensity relationships in the separate series, it is concluded that the glow is due to the recombination of ions and electrons. F. J. W.

2273. Charging of Particles Suspended in a Corona Discharge. H. Schweitzer. *Ann. d. Physik*, 4. 1. *pp.* 33–48, *Jan.* 18, 1930.

The charging of small drops of paraffin oil suspended in a corona discharge has been studied in order to determine (*a*) the magnitude of the charge; (*b*) the relationship between the radius of the particle and its charge. Further, since earlier studies of the purification of gases by electrical precipitation have not revealed whether the highly charged particles occur to a large extent and play a large part in the purification, this point has also been investigated. It is found that over the range of the concentration of ions in the corona the charge is almost independent of the concentration. The charge increases almost linearly with increase in the radius of the particle. Finally, in the electrical purification of gases highly charged particles occur rarely and are of no importance to the process. F. J. W.

2274. New Type of Electron Discharge in Hydrogen. J. Oishi and K. Yosioka. *Phys. Math. Soc. Japan, Proc.* 12. *pp.* 1–5, *Jan.*, 1930. *In English.*

A new type of discharge in thermionic tubes containing hydrogen is described, and details are given for its production. F. J. W.

2275. Spectral Phenomena in Spark Discharges. J. W. Beams. *Phys. Rev.* 35. *pp.* 24–33, *Jan.* 1, 1930.

Two methods are described for measuring the differences in the time of appearance of the spectrum lines in sparks. The first is a refinement of the Kerr cell method previously used, and a detailed description of its use is included. The criticisms of Gaviola [see Abstract 149 (1930)] of the method are shown not to apply. The second method makes use of a rapidly rotating mirror which either reflects the dispersed light of the spark to a photographic plate or the undispersed light to the slit of a spectrograph. In either case the position of the beginning of a line on the photographic plate gives its time of appearance. The method of Henriot and Huguenard [see Abstract 522 (1928)] was used to rotate the mirror. Photographs of sparks are shown with the mirror rotating 1830 r.p.s. However, higher rotational speeds have been used. It is concluded that the Kerr cell method is superior for examining the air lines in the initial stages of the spark, while the rotating mirror method is better in studying the appearance and duration of the metallic lines which are not present in the very first stages of the spark discharge. AUTHOR.

2276. Anode Spots and Their Relations to Absorption and Emission of Gases by Electrodes of a Geissler Discharge. C. H. Thomas and O. S. Duffendack. *Phys. Rev.* 35. *pp.* 72–91, *Jan.* 1, 1930.

In a Geissler discharge containing H_2, N_2, CO, mixtures of hydrogen and the rare gases or mixtures of mercury vapour in the rare gases at pressures of 0·5 to 12 mm. and electrode separation of 4 to 30 cm., the anode glow breaks up into a number of bright hemispherical spots, more or less symmetrically arranged when the polarity of a direct-current discharge is reversed. Anode spots do not form in O_2, A or Ne, but faint spots form in He which contain a trace of H_2. It is shown that one necessary condition for the formation of spots is the emission of gas from the surface of the anode. As many as 75 spots arranged in 5 concentric rings have been observed on an anode 34 mm. in diameter. Conditions governing the number, size and duration of the spots have been determined. Spots formed on all the metals tried; Fe, Ni, Al, Cu, Hg and brass. The formation of anode spots has been used to prove that in a Geissler discharge between cold electrodes, the kathode absorbs gas and the anode emits gas at rates which are functions of the current density, gas pressure, kind of gas and electrode temperature. It is shown that the increase of the potential drop of a discharge with time is due almost wholly to an increase in the gas content of the kathode, and that the potential drop immediately after starting a discharge is lowered by previously degassing the kathode by means of an induction furnace or by using this electrode as anode. AUTHORS.

2277. Electron Velocities in a High-Frequency Discharge in Hydrogen. C. J. Brasefield. *Phys Rev.* 35. *pp.* 92–97, *Jan.* 1, 1930.

A high-frequency discharge in hydrogen was obtained by applying undamped high-frequency voltages to the movable external electrodes of a cylindrical discharge tube. The mean velocity of the electrons in the discharge was determined from the ratio of the densities of certain singlet and triplet lines of the molecular spectrum of hydrogen. It was found (1) that the electron velocity increases as the voltage between electrodes is increased, the gas pressure and the frequency of oscillation being constant; (2) for a given voltage between electrodes, the electron velocity is, in general, greater the longer the wave-length of oscillation; (3) the electron velocity decreases as the pressure is increased. The paper concludes with a discussion of the mechanism of the high-frequency discharge in which an explanation of its behaviour is proposed. AUTHOR.

2278. Ionisation Potential of the NH_3 Molecule. R. Grinfeld. *Univ. Nac. La Plata, Estudio Ciencias, No.* 89. *pp.* 79–81, *Dec.*, 1929.

By the same method as was used for the water molecule [see Abstract 1363 (1928)], the author has found 16·1 ± 0·5 volts as the ionisation potential of NH_3. Grimm's law is thus fully confirmed by the experimental data. AUTHOR.

2279. Ionisation Potentials and Some Spectroscopic Experiments. M. Pierucci. *N. Cimento,* 6. *pp.* 412–417, *Dec.*, 1929.

The author refers to experiments carried out some years ago with various substances in the arc spectrum in the light of later discoveries of the ionisation potentials of the elements dealt with. Whilst he concludes that the rule of Franck and Hertz, that of two constituents of a mixture that radiates most strongly whose ionisation potential is less, is probably only a particular case of a wider physical law valid for a notable number of constituents and within somewhat extended limits of temperature and of pressure, he considers also that his experiments, according to which there was sometimes a total absence from the spectrum of some constituents, are (if not different from) something more than a simple extension of the experiments of Franck and Hertz as mixtures of rarefied gases. J. J. S.

2280. Ionisation of Alkali Atoms by Slow Electrons. H. Funk. *Ann. d. Physik,* 4. 2. *pp.* 149–184, *Jan.* 28, 1930.

Potassium and sodium were investigated. In each case an atomic beam was produced, and a beam of electrons of approximately homogeneous velocity was made to strike it at right angles. The resulting metal ions were caught in a metal cylinder, and the current due to them was measured; the primary electron current was measured in the same way. The experiments indicate a maximum of the ionisation area of the atom for about double the ionisation voltage, with the values 29 cm.^{2}/cm.^{3} for Na, and 11 cm.^{2}/cm.^{3} for K. J. J. Thomson's ionisation theory for collisions with electrons gives a maximum output for an electron velocity twice the ionisation voltages with a maximum of 54 % for Na and 50 % for K. The experiments give 70 % for Na and 20 % for K, and the curves showing the way in which the output rises to the maximum differ from the theoretical curves. The advantage of the method employed is that an electron will not, in general, collide with more than one atom of the metal in traversing the atomic beams, the result is that the mathematics of the problem is greatly simplified as compared with previous experiments, where the electrons passed through a considerable volume of gas and were repeatedly reflected by the atoms. H. N. A.

2281. Probability and Critical Potentials for the Formation of Multiple Charged Ions in Hg Vapour by Electron Impact. W. Bleakney. *Phys. Rev.* 35. *pp.* 139–148, *Jan.* 15, 1930.

With a type of apparatus previously reported [see Abstract 307 (1930)] the procedure is described for measuring the probability of the formation of multiple charged ions in mercury vapour as a function of the velocity of the incident electron. New results, together with those of an earlier paper, place the minimum or ionising potentials for the formation of Hg^+, Hg^{2+}, Hg^{3+}, H^{4+}, and Hg^{5+} by a single impact at 10·4, 30, 71, 143, and 225 volts respectively. A brief correlation of these results with those of other observers is given. A set of curves is given showing the fraction of the total positive ion current carried by each type of ion as a function of the electron velocity. Another set of curves shows the fraction of the total number of ions carrying one, two, three, four and five charges. The fraction for Hg^+ drops to a nearly constant value of 78 %, while the value for Hg^{2+} approaches 16 % of the total number beyond 150 volts. At 400 volts the values for the five ions in order are 77, 16·5, 4·4, 1·3 and 0·8 % in each case respectively. Curves are given representing the number, N of each type of ion, per electron, per cm. path, per mm. pressure at 0° C. as a function of the electron velocity. The values of N for Hg^+, Hg^{2+}, Hg^{3+} and Hg^{4+} have maxima of 20·8, 3·2, 0·72, 0·15 at 50, 115, 210 and 400 volts respectively. The effective cross-sectional area of the Hg atom toward an ionising collision of a given type is obtained by dividing the appropriate value of N by the number of molecules per cc. The maximum value of this area for Hg^+ is about 60 % of the kinetic theory value. A discussion is given of the meaning of the area under the peaks in the *e/m* analysis curves and its effect on the accuracy of the interpretation of the data. AUTHOR.

2282. Ionic Mobilities in Cl_2 and in Cl_2-Air Mixtures. L. B. Loeb. *Phys. Rev.* 35. *pp.* 184–192, *Jan.* 15, 1930.

Work of early investigators and of H. Mayer indicates that the presence of traces of Cl_2 reduces the mobility of the negative ion below that of the positive ion, a fact which appeared inconsistent with a theory of Condon and the writer. No investigations of mobilities of both ions in pure Cl_2 have been reported. The possibility that the discrepancy between theory and observation in Mayer's results was caused by HCl in the Cl_2 made a more careful investigation imperative. Cl_2 carefully prepared and free from both HCl and H_2O was used. It was found that the values of the mobilities in pure Cl_2 on the new absolute standard for positive and negative ions was 0·654 and 0·510 cm./sec. per volt/cm. respectively. A study of mixtures of dry air and Cl_2 showed that traces of Cl_2 less than 0·1 % reduce the negative mobility below that of the positive ion. The positive mobilities were little affected by the presence of Cl_2, so that while positive ions obey Blanc's law in Cl_2-air mixtures the negative ion shows a marked clustering effect. No disturbances due to dipole moments were observed for positive ions in Cl_2 as is to be expected. AUTHOR.

2283. Scattering and Absorption of Electrons by Lead in the Superconducting State. J. C. McLennan, J. H. McLeod and J. O. Wilhelm. *Roy. Soc. Canada, Trans.* 23. *Sect.* 3. *pp.* 269–277, *May,* 1929.

A glass tube containing about 18 mg. of mesothorium was placed at the bottom of a brass cylinder open at the top, and a sheet of pure lead 0·008 mm. thick was placed above the mesothorium; this cut down the intensity of the β-rays emitted by 61 % at room-temperature. The brass cylinder was contained in a glass bulb filled with helium, and the β-rays ionised this, the ionisation being measured by means of an electrometer. The bulb could be cooled down with liquid air, liquid hydrogen or liquid helium. No increase in the transparency of the lead plate to the β-rays took place when the lead became superconducting; there was actually a reduction of the saturation current through the gaseous helium, which appeared to be due to a lowering of the ionic mobilities at the lower temperature. Had the lead plate become perfectly transparent to the β-rays at 4·2° K, the intensity of the beam would have been increased by over 150 %. The experiment is of some importance in connection with the theory of electric conduction in metals. H. N. A.

2284. Effective Cross-Section of the Non-Inert Gas Molecule towards Electrons below 1 Volt. C. Ramsauer and R. Kollath. *Ann. d. Physik,* 4. 1. *pp.* 91–108, *Jan.* 18, 1930.

This paper continues the previous investigation for inert gases [see Abstract 1323 (1930)] and investigates hydrogen, oxygen, nitrogen, carbon monoxide, carbon dioxide and methane for electrons between 1 and 0·16 volt. The relationship to the Brüche curves is true for each case. N_2 and CO, CH_4 and A, Kr, show typical similarities above and below 1 volt, which is not the case for H_2 and He. The curves for all the cases show in part a rise and in part a fall towards zero voltage, and a theoretical discussion is included. Gas influence upon the photoelectric emission is vanishingly small for H_2, N_2, CO and CO_2, appreciable for CH_4, and very strong for O_2. H. H. Ho.

2285. Electron Impacts in Oxygen. J. E. Roberts and R. Whiddington. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 12–17, *Dec.*, 1929.

The apparatus was similar to that used by Jones and Whiddington for experiments on hydrogen, with certain improvements. The magnetic spectrum of the electrons showed a line representing electrons with the full primary velocity, and others corresponding to electrons which had lost definite amounts of energy by colliding with oxygen molecules. The first of these corresponded to a loss of 8·5 volts, the second to a loss of 12·9 volts. The explanation of these numbers is attempted, with the help of energy-nuclear separation curves drawn by the method of Morse for the electronic levels $1^3\Sigma$, representing the normal state, and $2^3\Sigma$, the upper state of the Lyman–Runge bands; an energy transfer of 9·46 volts seems to be suggested for the first line, and suggestions are made for explaining the difference between this and the observed value, 8·5 volts. The 12·9-volt loss is probably due to an atomic excitation. There is a shaded edge below the 12·9-volt line, which is very probably due to the ionisation of the molecule. H. N. A.

2286. The Electron Gun. R. Whiddington. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 18–20, Dec., 1929.

Suggests that the main part of the variation of curvature of the electron paths produced by a magnetic field, which is observed in an " electron gun," such as that used by the Western Electric Company in their low-voltage kathode-ray oscillograph, is due to a negative charge of the glass walls. Explains how this charge depends on the pressure of the gas in the bulb. In addition to this surface effect describes a volume effect, previously unknown, which also depends on the pressure. H. N. A.

2287. Secondary Electrons of High Velocity from Metals Bombarded with Kathode Rays. P. B. Wagner. *Phys. Rev.* 35. *pp.* 98–106, *Jan.* 1, 1930.

The magnetic spectra of high-speed secondary electrons emitted by Au, Ag and Al, when bombarded with kathode rays of from 16 to 40 kV, have been photographed and densitometered. Beginning at the high-velocity end, the density is zero down to energy $e\,V_0$, equal to that of a primary ray, then rises rapidly to a maximum at about 0·94 eV_0 for Au or Ag, or 0·85 eV_0 for Al, and then declines. The density is everywhere continuous. Its first derivative may be discontinuous at $e\,V_0$, but nowhere else. Thin targets show spectra sufficiently like those of thick targets to indicate that most of the secondary electrons come from very near the surface: for Au, within 0·2 micron even up to 40 kV; for Ag, over 0·2 micron only above 20 kV; for Al, over 0·5 micron only above 20 kV. AUTHOR.

2288. Excitation and Bleaching of Photoelectrically Conducting Alkali Halides. A. Smakula. *Zeits. f. Physik*, 59. 9–10. *pp.* 603–614, 1930.

These compounds are converted by ultra-violet light of the recently discovered dispersion frequencies, or by X-rays, into photoelectrically conducting bodies with " foreign colouring of the first kind." The carriers of the coloration are apparently alkali metal atoms. Absorption of light, the wave-length of which lies in the principal band by such a crystal causes a "bleaching" of the colouring, and an excitation; both these phenomena are consequences of a photoelectric breaking off of electrons; the first phenomenon is irreversible, while the second is reversible. It is shown that for all wave-lengths within the absorption band, and for all temperatures, one light quantum is necessary in the limit for each centre, consisting of an alkali atom loosely bound in the lattice, provided one confines oneself to small amounts of light energy. The proportion between the excited and the "bleached" centres can vary very greatly with the kind of crystal and the temperature. In natural crystals, and in synthetic crystals at low temperatures, the highest values of the excitation, 100 %, are found. The effect of excitation on the absorption spectrum, which had previously been studied at ordinary temperatures with NaCl, has been observed with other alkali halides, and in particular with KCl, at — 186° C. Concludes that the alkali metal atoms in question are not joined together in large complexes, but are arranged somehow singly in the crystal lattice. H. N. A.

2289. Schottky Effect and Contact Potential Measurements on Thoriated Tungsten Filaments. N. B. Reynolds. *Phys. Rev.* 35. *pp.* 158–171, *Jan.* 15, 1930.

The Schottky effect for thoriated tungsten filaments is investigated, and Schottky's relation that $\log i \propto (V)^{1/2}$ is verified at high fields, but fails at gradients below 10,000 volts/cm., even for fully activated surfaces. This lack of saturation at low fields is accentuated by the effect of bombardment with high-velocity positive ions, such bombardment apparently producing a surface roughening and consequently increased fields in local areas. Investigation with low accelerating and retarding voltages, while varying the temperature and state of activation of the filament, allows a comparison of the contact potential and the work function at the absolute zero of temperature (ϕ_0) for the thoriated surface. The two values (contact potential and ϕ_0) are found to vary with a one-to-one correspondence if ϕ, the work function at the temperature of measurement, be allowed a temperature coefficient. This coefficient is much larger than can be attributed to the specific heat of the electrons in the metal. The electrons with high velocities show a Maxwellian velocity distribution. Near the zero of potential there are certain anomalous effects, and a "patch surface" is postulated, which, in a qualitative manner, explains this behaviour and the lack of current saturation with voltage gradients below a limiting value. AUTHOR.

2290. Temperature Dependence of Field Currents. N. A. de Bruyne. *Phys. Rev.* 35. *pp.* 172–176, *Jan.* 15, 1930.

The increase in the field current observed by Millikan and Eyring to take place at about 1000° K is shown to be of the order of magnitude of the thermionic emission to be expected from a thoriated filament at this temperature. The author considers that the results of Millikan and Lauritsen are inconclusive and do not definitely establish the existence of a dependence of field currents upon temperature. The author has carried out new experiments, using an improved method of investigation, and has been unable to detect any temperature variation in the field current. His contention is not that no temperature variation exists, but that no real variation has yet been observed. AUTHOR.

2291. Neutralisation of Space Charge by Positive Ions in Cæsium Vapour. V. E. Whitman. *Bureau of Standards, J. of Research,* 4. *pp.* 157–167, *Jan.*, 1930.

A tube was constructed in which the neutralisation of space charge by positive ions was studied. The positive ions were formed by the photoelectric ionisation of cæsium vapour. The change in current due to the illumination was measured as a function of such controllable variables as pressure, light intensity, anode voltage, and kathode emission. An empirical relation between change in anode current and illumination is given which may be fitted to the experimental results by adjusting one constant. AUTHOR.

2292. Space Charge Distribution between a Plane Hot Kathode and a Parallel Anode. H. Rakshit. *Phil. Mag.* 9. *pp.* 80–87, *Jan.*, 1930.

A theoretical paper giving the distribution of electron density between a plane heated kathode and a parallel anode when a thermionic current flows between the two. The electron density diminishes immediately near the hot surface, but increases at a greater distance from it. Some special conditions are worked out numerically and shown in graphs.

W. H. GE.

2293. Oscillations of Quartz Plates. A. Lissütin. *Zeits. f. Physik,* 59. 3–4. *pp.* 265–273, 1930.

A mathematical treatment is given for the case of a rectangular plate of quartz oscillating simultaneously in two directions. The solutions for the displacements along the axes are obtained in the form of trigonometrical series. The limiting conditions for oscillation are shown to involve rational relations between the lengths of the sides of the quartz plate. The paper concludes with an investigation of the equilibrium of a quartz plate in an electric field. A. W.

2294. Critical Frequency in an Ionised Medium. Steady Magnetic Force Present. T. L. Eckersley. *Phil. Mag.* 9. *pp.* 225–232, *Feb.*, 1930.

The present paper is an extension of previous work [see Abstract 2978 (1927)], and examines the effect of a magnetic field on the critical frequency. The momentum balance is shown to be the same as in the previous case, and the waves are brought to a standstill for the same reason, *i.e.*, the transference of wave momentum to the ions. The simple case in which the magnetic force R is parallel to the ray is first investigated, and it is shown that an overdense medium may become transparent if a sufficiently strong magnetic field is introduced. In the case when the ray direction makes an angle θ with R the conditions become more complex, but it appears to the author to follow quite definitely that the application of a sufficiently intense magnetic field to an overdense medium will make the latter transparent for a finite range of angles in accordance with the dictates of the phase-velocity equations. As a result it follows that sufficiently long waves can penetrate the Heaviside layer when the earth's magnetic field is taken into account.

F. S. B.

2295. Mechanism of Magnetisation. Helene Trosien. *Ann. d. Physik,* 4. 1. *pp.* 109–120, *Jan.* 18, 1930.

If a definite magnetisation is produced in a ferromagnetic material by a direct-current field, and then a very strong alternating field is superposed upon the direct-current field, and this latter decreased steadily to zero, there is obtained what Steinhaus and Gumlich call the ideal magnetisation curve. In this paper an account is given of an investigation of the way in which the magnetisation depends upon the decrease of the alternating field. There exists in the ion a magnetisation which is compounded of a temporary constant and a periodic portion. As approximately the direct-current field may be regarded as an unchanged parameter, the constant portion of the magnetisation is a pure function of the amplitude of the alternating field. The behaviour of iron and steel under these conditions was studied, and the results are given in a series of curves. J. J. S.

2296. Magnetic Susceptibilities of Single Metallic Crystals. J. C. McLennan and Elizabeth Cohen. *Roy. Soc. Canada, Trans.* 23. *Sect.* 3. *pp.* 159–168, *May*, 1929.

Continuing with the same methods [see Abstract 986 (1929)], crystals of Te, Sn, Bi, Sb and Se were examined. In Te and Sn, no change of susceptibility was noted as the crystal was rotated about its cylindrical axis. For Te, χ is $-0\cdot308 \times 10^{-6}$, and for Sn, $0\cdot024 \times 10^{-6}$. Bi has minimum χ parallel to the trigonal axis and maximum at right angles to this axis. At the temperature of liquid air, χ along the trigonal axis increased from $1\cdot16$ to $1\cdot42 \times 10^{-6}$. Single crystals of Sb behave like Bi with respect to susceptibility and direction, but no change in χ is noted when the temperature is lowered to that of liquid air. The values of χ found were maximum $-1\cdot13 \times 10^{-6}$, and minimum $-0\cdot63 \times 10^{-6}$. Single crystals of Se were not obtained, and χ $0\cdot29 \times 10^{-6}$ was found for both amorphous and metallic forms. G. E. A.

2297. Magnetic Resistance Variation and Spontaneous Magnetisation. W. Gerlach. *Zeits. f. Physik*, 59. 11–12. *pp.* 847–849, 1930.

Shows that the results obtained by Williams [see Abstract 1046 (1905)] are confirmed by the most recent experiments. At temperatures just below the Curie point a longitudinal magnetic field produces a decrease in resistance. This is indicated by the fact that increasing the temperature of the ferromagnetic material causes a lowering in the rate of resistance increase until near the Curie point it changes to an actual decrease in resistance values. This effect is naturally connected with the spontaneous magnetisation, leading to an increase therein since the resistance is decreasing. R. C. F.

2298. Energy Interpretation of the Molecular Field, and Paramagnetic Magnetisation. P. Weiss. *J. de Physique et le Radium*, 1. *pp.* 1–10, *Jan.*, 1930.

The sole condition that a paramagnetic body should follow the Curie-Weiss law is that its energy depends on its magnetisation by the term $n\sigma^2/2$, where n is a constant, obtained by dividing the temperature of the Curie point by C, the Curie constant, and σ is the magnetisation. This result is tested by graphing $1/\chi T$ with $1/T$, using the observations of Chatillon and Mlle. Serres on Co'' in cobalt sulphate, which has three moments, 25, $25\cdot67$ and 26 magnetons. The general theory is insufficient to explain this difference, but the energy condition indicates that the carrier of the magnetic moment must be part of an ion which undergoes relative displacement as a result of the action of the field. G. E. A.

2299. X-Ray Search for the Origin of Ferromagnetism. J. C. Stearns. *Phys. Rev.* 35. *pp.* 1–7, *Jan.* 1, 1930.

A sensitive null method, employing two crystals and two ionisation chambers, was used to detect any change in intensity of an X-ray beam reflected from a magnetic crystal, when this magnetic crystal was magnetised. This method was capable of detecting from 1·0 to 0·1 % change in intensity, according to the intensity of the reflected beam. Crystals of magnetite and silicon steel were used. No change of intensity was observed, although the theoretical change was several times that which could have been detected. The change in intensity of the X-ray beam was computed on the basis of the alteration of the structure factor due to orientation of electronic orbits by the magnetic field. It is concluded that electrons revolving in orbits within the atom cannot account for ferromagnetism. The models of Honda and Ehrenfest are briefly discussed. On the basis of present atomic models and present experimental evidence it appears that the ultimate magnet should be identified with the spinning electron. AUTHOR.

2300. Magnetic Viscosity. C. Lapp. *Ann. de Physique,* 12. *pp.* 276–277, *Oct.,* 1929.

A reply to Bozorth [see Abstract 2837 (1928)] in which it is claimed that the lag on passing from saturation to a weak magnetisation (but not to saturation of opposite sign) is not due to induced currents but to magnetic viscosity. T. M. L.

2301. Diamagnetism of Ions. P. Weiss. *Comptes Rendus,* 190. *pp.* 95–98, *Jan.* 13, 1930.

Reference is made to earlier work by Pauling, van Vleck, Stoner and Hocart, and the difficulties encountered. The author uses the results of Hocart on NaCl and KCl when in solution and when crystalline, and of Fajans and Joos to provide a means of deducing the alterations of diamagnetism and refraction. Good agreement with theory is obtained for NaCl and KCl, where changes of refraction are twice as large as those for diamagnetism. Values are obtained first for the paramagnetism of H^+ in solution, and values are then deduced for Na^+, K^+ and Ca^{++} and for I^- and Br^-. In a table are then compared the theoretical results of Pauling and Stoner with the experimental values of Hector and Wills, Hocart and of Reicheneder for Cl^-, Br^-, I^-, He, Ne, A, Na^+, K^+, Mg^{++}, Ca^{++} and Sr^{++}. The agreement is better than that by Hocart indirectly from crystalline potassium salts. For He there is excellent agreement between Stoner's and Hector and Wills' values, but for others it is not good. [See Abstract 338 (1930)]. R. S. R.

2302. Anomaly in the Diamagnetism of Gases. A. Glaser. *Ann. d. Physik,* 4. 1. *pp.* 82–90, *Jan.* 18, 1930.

A reply to criticism of his second method [see Abstract 1999 (1930)] with special reference to the criticism of Buchner. By means of thermocouples he makes sure that nowhere in his apparatus can there have been a difference of temperature amounting to 0·01° C. E. E. F. d'A.

2303. Possibility of Observing the Magnetic Moment of the Free Electron. F. Knauer. *Zeits. f. Physik,* 59. 11–12. *pp.* 807–811, 1930.

Proposes a method by means of which the author considers that it should be possible to measure the magnetic moment of a free electron in an electric beam, by neutralising the Lorentz force by means of a suitably arranged electric field. Certain difficulties in the method have been pointed out to the author by Bohr and Klein, and others by Lenz; in spite of these the author considers that further discussion of the problem is required. H. N. A.

2304. Effect of Tensile Overstrain on the Magnetostriction of Steel. J. S. Rankin. *Roy. Techn. Coll., Glasgow, J.* 2. *pp.* 173–187, *Jan.*, 1930.

An apparatus is described for detecting the change in the magnetostriction of steel after it has been subjected to different degrees of overstrain. It is shown that, whereas hard high-carbon steel shows less magnetostriction than soft low-carbon steel, magnetostriction is greatly increased when soft low-carbon steel is hardened by tensile overstrain. A theory, based on Webster's experiments on the magnetostriction of an iron crystal, on Joffé's analysis of plastic deformation, and on the results of the X-ray analysis of overstrained material, is suggested to account for the experimental results obtained. An Appendix is added describing experiments on the magnetostriction of nickel, and of 25 % and 30 % nickel steel. [See also Abstract 2601 (1929)]. AUTHOR.

2305. Damping Produced by Eddy Currents and its Application to Determination of Resistivity. Part I. S. Davies and E. J. Evans. *Phil. Mag.* 9. *pp.* 1–16, *Jan.*, 1930. *Part II.* **E. S. Keeping,** *ibid., pp.* 16–23.

Spheres and cylinders of metals and alloys were allowed to oscillate pendulum fashion between the pole-faces of a powerful electromagnet, which were inclined at a small angle to give a non-uniform field along the line of swing of the pendulum. Theory shows that for a sphere the difference between the logarithmic decrements with the magnetic field on and off respectively is proportional to $\left(\frac{dH}{ds}\right)^2 \cdot \frac{1}{\rho} \cdot \frac{1}{d} \cdot D^2 \cdot T$, where $\frac{dH}{ds}$ is the field gradient along the swing, ρ and d are the resistivity and density of the substance of the sphere of diameter D and $T = 2\pi\frac{l}{g}$, the pendulum constant. Analogous results hold for oscillating cylinders. The experiments confirm the form of the above relations, and by measuring H along the swing path with a fluximeter, the values of the constants of proportionality were determined which agree with those by mathematical analysis. The method can be used for comparing the resistances of conductors in the form of spheres or cylinders or for determining resistivities absolutely. W. S. S.

2306. Mutual Action of a Pair of Rational Current Elements. G. F. C. Searle. *Phil. Mag.* 9. *pp.* 92–96, *Jan.*, 1930.

A theoretical paper giving an elementary account of the calculation of the mutual action of two rational current elements. The results had been given, but not proved, by Heaviside. W. H. GE.

APPARATUS AND INSTRUMENTS.

2307. Exactness of Measurements of High Potential by Means of the Spectrograph. F. Vierheller. *Univ. Nac. La Plata, Estudio Ciencias, No.* 89. *pp.* 189–202, *Dec.*, 1929.

The methods are described for the measurement of high potentials used in X-ray excitation, particularly with respect to the sphere spark gap and by means of the spectrograph. (1) *Sphere Spark Gaps.*—Tables are given relating the approximate relation between spark length and temperature, with corrections for temperature and atmospheric pressure. (2) *Spectrographic Method.*—The application of the Seemann spectrograph and sources of error are discussed, and 20 spectrographs obtained at two different potentials are given. A method is described, using a scale of blackening, which gives an absolute value of blackening. By means of the spectrographic method an accuracy of 0·25 % can be obtained at voltages about 190 kV, and a still greater accuracy for voltages about 100 kV. B. J. L.

2308. Laboratory Method of Producing High Potentials. G. Breit, M. A. Tuve, and O. Dahl. *Phys. Rev.* 35. *pp.* 51–65, *Jan.* 1, 1930.

Details are given of the experimental arrangement by which, using Tesla coils in oil, very high potentials have been produced and measured. Excited at the rate of 120 sparks per sec. Tesla coils have been operated at 3,000,000 volts in ordinary transformer oil at atmospheric pressure. In oil under a pressure of 500 lbs. per sq. in. voltages as high as 5,200,000 have been produced with intermittent excitation. These voltages (peak values) are measured by a simple capacity-potentiometer, in which an insulated electrode "picks up" a known fraction of the total voltage, this fractional voltage being measured by means of a sphere gap. Measurements are given of the voltage-distribution along Tesla coils. Calculations and measurements of the efficiency and power-output of such coils show that at 120 sparks per sec. a coil operating at 5,000,000 volts provides sufficient power, if used to accelerate helium nuclei in a suitable vacuum-tube, to yield the equivalent of about 2600 gm. of radium. AUTHORS.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

2309. Action of Low-Velocity Electrons on Micro-Organisms. D. A. Wells. *Nature,* 124. *pp.* 983–984, *Dec.* 28, 1929.

An account of the results of experiments on the bactericidal power of beams of electrons of variable velocities. The experimental arrangement is described. It is found that (1) Staphyloccus albus can be subjected to a vacuum of $5 \cdot 10^{-6}$ mm. of mercury for eight hours without showing signs of killing; (2) it may be killed by low-velocity electrons (30 volts); (3) the lethal action is a function of the individual energy of the electrons, 19·5–25 volts showing little or no killing; (4) the percentage killed at constant electronic energy is a function of the total energy of exposure. W. V. M.

2310. Advantages of Valve Rectification. W. E. Schall. *Brit. J. of Radiology,* 3. *pp.* 24–37, *Jan.,* 1930.

The rectification of sine form high-tension energy to give unidirectional high-tension energy for the purpose of exciting X-ray tubes is discussed, with respect to rectification by means of the mechanical rectifier and by means of four valves in Graetz connection. Apparatus is also discussed for the production of a constant potential by means of condensers. The author is strongly in favour of valve tube rectification. In the *Discussion*, several speakers spoke in favour of mechanical rectification. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

2311. X-Ray Studies on Adsorption. M. Hirata. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 450–453, *Dec.*, 1929. *In English.*

The X-ray diffraction rings of propyl alcohol adsorbed on the cocoa-nut charcoal have been photographed. The vapour pressure of the propyl alcohol in equilibrium with the charcoal varied from 2–13·6 mm. In all cases, the maximum of the diffraction ring remained undisplaced by change in vapour pressure. The maximum could not be attributed to a simple superposition of diffraction rings due to liquid propyl alcohol and charcoal. The same is true of the diffraction rings obtained from charcoal containing adsorbed methyl, ethyl, amyl, and octyl alcohol. It is necessary to assume, therefore, that the molecular state of the adsorbed alcohol molecule is different from that of the molecule in the liquid. In contrast to the results obtained with the alcohols, the system carbon disulphide/charcoal gave diffraction rings which were identical with those expected from the simple superposition of the rings due to charcoal and liquid carbon disulphide. The molecular states of adsorbed and liquid carbon disulphide are probably not very different therefore. F. J. W.

2312. Statistical Foundation of the Langmuir Adsorption Formula. K. Kar and A. Ganguli. *Phys. Zeits.* 30. *pp.* 918–920, *Dec.* 15, 1929.

The Langmuir adsorption isotherm has been developed using the methods of statistical mechanics. It is further suggested that if the adsorbed gas is in the solid state then the heat of adsorption should be equal to the heat of sublimation of the adsorbed substance in the solid state. This prediction has been tested against the work of Homfray, Tittoff, Richardson and Patrick. The results of the test are satisfactory for adsorption at ordinary temperatures; but considerable discrepancies occur at low temperatures. It is suggested that these discrepancies are to be attributed, partly at least, to the errors in the heats of sublimation at low temperatures. F. J. W.

2313. Rate of Adsorption of Mixtures of Gases Containing Alcohol and Ether in Addition to Air, by Silica Gels. L. v. Putnoky and G. v. Szelényl. *Zeits. f. Elektrochem.* 36. *pp.* 10–15, *Jan.*, 1930.

In a previous paper [see Abstract 1346 (1929)] the adsorption of alcohol and ether by five varieties of silica gel was investigated. The work was continued on silica gel prepared by the hydrolysis of silicon tetrachloride, and the adsorption of alcohol and ether, separately, by this gel was determined. The adsorption was measured at three different vapour pressures. Curves of the adsorption and desorption were given. It was found that the adsorptive power of the gels increased with the increase of vapour pressure of both the alcohol and ether, and that this increase was greater for the adsorption of alcohol vapour than for ether.

F. J. B.

2314. Nature of "Active" Carbon. H. H. Lowry. *J. Phys. Chem.* 34. *pp.* 63–73, *Jan.*, 1930.

In several previous papers [see Abstract 619 (1929)] data have been given which indicate that the adsorptive capacity of carbon is increased by any processes which increases either the total surface per unit weight or the degree of saturation of the surface atoms, or both. No exceptions to this generalisation have been encountered. It is now shown that an increase in the temperature to which the raw material is heated above 1000° decreases the adsorptive capacity per unit pore volume, the data indicating that the activity of a charcoal is independent of the atmosphere in which it is prepared, and dependent only on the maximum temperature to which it is heated. In agreement with the fact previously shown, that the hydrogen content of a charcoal decreases with increasing temperature of preparation, the data also show a regular dependence of activity on hydrogen content for values less than about 0·5 % corresponding to a temperature of 1000° C. Support is given to the previous conclusion (*loc. cit.*) that the simultaneous decrease in activity and hydrogen content above 1000° C. is to be attributed to a gradual crystallisation of the carbon. The various mechanisms involved are discussed.

H. H. Ho.

2315. Solubilities of Helium, Neon and Argon in Water and Organic Solvents. A. Lannung. *Am. Chem. Soc., J.* 52. *pp.* 68–80, *Jan.*, 1930.

The solubilities l of helium, neon and argon in water, methyl and ethyl alcohols, acetone, benzene, cyclohexane and cyclohexanol have been determined in the temperature interval 15° to 37°. Log l varies linearly with 1/T for the organic solvents, but not for water. In the formula $l = ae^{u/RT}$, where u is the heat of solution, it is found that for monatomic molecules, diatomic molecules and for carbon dioxide there is an approximate linear ralation between log a and u.

H. H. Ho.

2316. Growth Phenomena in Small Drops Caused by Diffusion and Dissolution. N. v. Raschevsky. *Zeits. f. Physik*, 59. 7–8. *pp.* 558–561, 1930.

In previous papers [see Abstracts 321 and 2009 (1929)] drop systems were investigated which grow by diffusion from without with subsequent chemical reaction. The growth-curves of such drops are now studied under the assumption that in addition to mass increase by diffusion of external substances, there also occurs a simultaneous decrease in mass by dissolution at the surface. It has been established that drop existence is impossible below a definite magnitude, so that for growth a definite minimum size must exist. Creation of a drop *per se* is impossible, but drops can increase in number by subdivision. Analogies with certain life processes are discussed.

H. H. Ho.

2317. Compressibility of Aqueous Solutions. E. P. Perman and W. D. Urry. *Roy. Soc., Proc.* 126. *pp.* 44–78, *Dec.* 2, 1929.

The apparatus described permits of the measurement of compressibilities for a pressure range 1 to 200 atmospheres, and for temperatures up to 80° C. Results are given for solutions of sucrose, urea, potassium chloride and calcium chloride at different concentrations up to nearly saturation. In discussing the results it is shown that a formula connecting the molecular compressibility of the solution with that of the solvent, and the molecular concentration, advanced by Gilbault, fits well and indicates that the dissociation is complete in the electrolyte solutions, thus confirming the Debye-Hückel theory. Osmotic pressures are calculated from a modification of Porter's general equation, using previous measurements of the vapour pressures and the present determinations of the compressibilities. W. S. S.

2318. Brownian Movement in Surface Films. H. A. McTaggart. *Roy. Soc. Canada, Trans.* 23. *Sect.* 3. *pp.* 153–158, *May,* 1929.

When a small bubble of air covered internally with a film of oil is placed in water, it slowly diminishes with simultaneous formation of a number of small nuclei or globules which under suitable illumination are seen to be endowed with Brownian movement [see Abstract 1120 (1928)]. Further experiments show that similar small globules occur in a film on a flat surface. Photographs of the phenomenon are reproduced. T. H. P.

2319. Structure of Surface Films. Part XIII. Sterols and their Derivatives. N. K. Adam and O. Rosenheim. *Roy. Soc., Proc.* 126. *pp.* 25–34, *Dec.* 2, 1929.

The continued researches [see Abstract 387 (1929)] show that the surface films of substituted cholesterols vary greatly in their character, though most of the substances studied have practically the same ring system. A change in the position of a substituent group may profoundly alter the area of a surface film and its compressibility under surface pressure. That would not be surprising with the water-soluble group which become anchored to the water, as their position would affect the tilt of the molecules. But the transmutation of CHOH into CO (in the case of cholestenone and its oximes) also affects the film structure, and it remains doubtful whether the effects are due to tilting of the molecules without deformation, to deformation or to both. A few of the films are solid and unstable. The area of the uncompressed monomolecular film of cholesterol, previously stated to be 39 sq. Å., is found to be 40·8 sq. Å. Oxycholestenone and its derivates give films the properties of which can hardly be explained on the basis of the accepted formulæ. H. B.

2320. Surface Films of Oleic Acid on Mercury. F. Émir. *Comptes Rendus,* 190. *pp.* 176–178, *Jan.* 20, 1930.

Describes apparatus in which the behaviour of a surface film of oleic acid deposited on a mercury surface can be studied in an atmosphere of nitrogen, using a " pump " arrangement similar to those employed by A. Marcelin and by Devaux for experiments in air. The " pump " has a piston consisting of a band of cellophane, and a valve consisting of a band of thin mica, which divides the " pump body " from the rest of the mercury surface, from which the gas is pumped as completely as possible. It proved impossible to eliminate completely oxidation of the mercury surface, but the following preliminary results were obtained. The behaviour of the oleic acid on mercury was similar to that on a water surface, the phenomenon of saturation being observed. The superficial pressure corresponding to saturation is 60 dynes/cm., or about double that observed on water. The thickness of the saturated film is 24 Å., and 23 Å. has been observed with water. It appears that in both cases the molecules are in contact at the saturation point, and that the orientation of the molecules is the same with mercury and with water. H. N. A.

2321. Method of Measuring Osmotic Pressure. W. Mund. *Ann. Soc. Sci. de Bruxelles,* 49. *pp.* 257–260, *Dec.,* 1929.

A vertical glass tube is closed at its upper end with a porous membrane and its lower end plunged into mercury, the cavity being filled with pure water. The whole apparatus is enclosed in an isothermic sheath, which carries close to the membrane a small capsule containing a solution of arbitrary concentration. The effect of the vapour pressure due to this solution can be determined by the rise of the mercury in the tube, and it is shown how the evaluation of the observations can be arrived at.

J. G. H. B.

2322. Abnormal Osmosis at Non-Swelling Membranes. K. Söllner. *Zeits. f. Elektrochem.* 36. *pp.* 36–47, *Jan.*, 1930.

Abnormal osmosis is the flow of a liquid stream through a membrane between electrolyte solutions of different concentrations, with a strength or direction incapable of explanation by normal osmotic forces. This phenomenon may be readily explained by the activity of electrical forces. At every membrane, owing to irregularity in constitution, different dynamic potentials exist from place to place and from pore to pore. This effects the formation of electrolytically short-circuited liquid cells, in which a closed current flows. Thus, membrane particles or pores with the higher dynamic membrane potential act as sources of current, and those with smaller potentials as electroosmotic diaphragms. T. H. P.

2323. Influence of Autoclave Treatment on the Form of Hydroxides and the Nature of Colloidal Suspension. T. Katsurai. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers No.* 219. *pp.* 161–166, *Dec.* 20, 1929. *In English.*

Hydroxides of various metals are produced by addition of alkali to a solution of metal salt until it becomes slightly alkaline, the alkali being so chosen that even when in excess it does not dissolve the hydroxide. The hydroxide is placed in an autoclave which is heated until the required pressure is reached. After treatment for an hour the autoclave is slowly cooled. With ferric hydroxide the gelatinous precipitate is completely changed to rouge by pressures of 10, 20 or 40 atmospheres; lead hydroxide is changed to a non-gelatinous powder; chromium hydroxide yields a slightly gelatinous form. No change is observed in the form of hydroxides of magnesium, aluminium, nickel, cobalt, or a mixture of hydroxides of aluminium and iron. A sol of $K_2Zn_3[Fe(CN)_6]_2$, stable on standing or boiling at atmospheric pressure, is coagulated on treating as above to pressures of 5 to 20 atmospheres. On similar treatment copper ferrocyanide sol is completely coagulated to a yellow-brown precipitate, Prussian Blue and Turnbull's Blue sols, and potassium ferrocyanide solution, yield coagulated precipitates of rouge, but no change occurs in barium sulphocyanate solution. Arsenic sulphide at 10 atmospheres is dissolved completely to a clear solution and cannot be coagulated. Silver chloride, bromide and iodide are completely coagulated at 10 atmospheres. A. J. M.

2324. Electrokinetic Potential and its Relation to the Rate of Coagulation of Colloids. Part I. B. N. Ghosh. *Chem. Soc., J. pp.* 2693–2703, *Dec.*, 1929.

It is observed that the stability of a colloid in general depends upon (1) the size of its particles, (2) their electrical charge, and (3) their state of solvation. For lyophobic sols, solvation is very small. For arsenious sulphide sol in presence of equi-coagulating concentrations of different electrolytes measurements show that for multivalent kations the electrokinetic potential varies between 13·9 and 15·1 millivolts, whereas for univalent kations it varies within wide and higher limits. For nearly the same rate of coagulation, addition of small quantities of potassium or lithium chloride to various multivalent electrolytes increases the electrokinetic potential markedly. With chloride, sulphate, oxalate and ferricyanide of potassium, sodium hydroxides, and aniline sulphate as coagulators, it is shown that ferric hydroxide sol becomes unstable when its potential falls to about 32 millivolts. Arsenious sulphide sol shows a peculiar behaviour as acceleration or retardation of the coagulation velocity is not accompanied by a corresponding change in its potential. J. K.

2325. Dielectric Polarisation and Structure of Hydrophilic Colloids. N. Marinesco. *Comptes Rendus*, 189. *pp.* 1274–1276, *Dec.* 30, 1929.

Debye's theory of the dielectric polarisation of solutions may be used to determine micellar magnitudes and to explain peculiarities in the inductive power of colloids observed by the author [see Abstract 2854 (1929)]. One gramme of substance in a colloidal solution fixes a volume of water given by $\omega = (V_E - V_S)/M$, where V_E and V_S are the molecular volumes in the dissolved and solid states respectively and M is the molecular weight. From ω the values of the polarity of the solution and of the electric moment may be calculated. The hydrophile coefficient, *i.e.*, the number of grammes of water fixed per gramme of dry colloid, is 8 to 10 for gelatin, and 11 to 13 for egg albumin with a minimum at the isoelectric point. Thus, the proteins are highly hydrated and may be regarded as typical of the hydrophilic colloids defined by Perrin. T. H. P.

2326. Influence of Light on the Coagulation, Electrical Conductivity and the Absorption Spectra of Colloids. (Miss) S. Roy and N. R. Dhar. *J. Phys. Chem.* 34. *pp.* 122–137, *Jan.*, 1930.

Reference is made to the work of Young and Pingree on the influence of illumination on the cataphoretic movement of sols like $Fe(OH)_3$, As_2S_3, mastic, common rosin, chlorophyll, etc. The authors also refer to an earlier work of their own on the effect of sunlight, wherein in several cases it was proved that light has a coagulating effect on sols. The present work refers to the influence of sunlight and in certain cases light from a Pointolite lamp with suitable light filters on different sols. A quartz spectrograph is employed under exactly comparable conditions. It is found that to one group can be classed those sols the stability of which decrease by exposure, while to another group can be placed sols the stability of which increase with exposure. Sols of ferric hydroxide, chromium hydroxide, zirconium hydroxide, ceric hydroxide prepared in the hot condition, vanadium pentoxide and manganese dioxide become less stable on exposure to light. Prussian blue, cupric ferrocyanide, mastic and gum dammar are stabilised on exposure to light. Arsenious sulphide becomes unstable towards mono- and bivalent electrolytes, but stable towards tri- and tetravalent kations. The electrical conductivities of sols $Fe(OH)_3$, $Cr(OH)_3$, $Zr(OH)_4$, $Ce(OH)_4$ hot, MnO_2, As_2O_3, Prussian blue, cupric ferrocyanide increase on long exposure to light. The specific conductivities of vanadium pentoxide, gum dammar and mastic decrease on exposure. J. K.

2327. Structure of Gelatin. J. J. Trillat. *Comptes Rendus*, 190. *pp.* 265–267, *Jan.* 27, 1930.

Examines a gelatin of $pH = 6{\cdot}2$, using the K-radiations of copper in three perpendicular directions. The gelatin is also studied in three different states, at rest, after drying on a thread, and in a stretched condition. The results obtained for each condition are briefly discussed, whilst the structure of gelatin is shown to consist of principal valency chains formed by joining end to end elementary groups of length 9·7 Å. A certain number of these chains form a crystallite, whilst a number of crystallites form a micelle. Gelatin consists of two phases, one amorphous with a low index of polymerisation and incapable of forming long chains, the other strongly polymerised, composed of elements in chains susceptible to orientation under mechanical effects. This two-phase structure appears to be general with a number of solid colloidal gels. Further, the orientation of the crystallites is different for the dried and the stretched conditions. R. C. F.

2328. Structure and Stability of Colloidal Particles. S. Liepatoff. *Kolloid Zeits.* 50. *pp.* 74–76, *Jan.*, 1930.

A theoretical paper based on the theories of v. Weimarn. J. K.

2329. Thermal Expansion of Zinc and Cadmium Crystals and Crystal Structure of Erbium and Niobium. J. C. McLennan and R. J. Monkman. *Roy. Soc. Canada, Trans.* 23. *Sect.* 3. *pp.* 255–267, *May*, 1929.

A camera of the Seeman and Horowitz type, modified to enable the crystal structure at very low temperatures to be studied with considerable accuracy, is described. By determining the lattices of zinc and cadmium at ordinary temperatures and at the temperature of liquid air, the thermal expansions of these metals over that range of temperature has been measured. Values are given for the principal axes, and it is found that the actual values of the coefficients decrease with temperature, but the ratio between them remains constant. With the same camera the crystal structures of erbium, tantalum and niobium have been studied. For erbium, a close-packed hexagonal structure is deduced ($a_0 = 3 \cdot 74 \times 10^{-8}$ cm. and axial ratio, 1·63). The tantalum lattice has been redetermined, and a body-centred cube with $a = 3 \cdot 291$ Å. is indicated (cf. Hull $a = 3 \cdot 272$ Å.). The niobium samples gave the tantalum lines and some others, which could not be analysed. Either it has the same lattice as tantalum, or it is not a body-centred cube. C. O. B.

2330. Properties of Phases of Transition Elements in Binary Systems with Boron, Carbon and Nitrogen. G. Hägg. *Zeits. f. phys. Chem.* 6. *Abt. B.* 3. *pp.* 221–232, *Dec.*, 1929.

By comparison of the properties determined, it is shown that the phases between boron, carbon and nitrogen with the transition metals are metallic in comparison with the phases between these metalloids and other metals. These regularities are probably caused by the small atomic dimensions of the metalloids concerned. Definite regular variations of physical and chemical properties have been established for phases of the transition metals with boron, carbon and nitrogen. From the fact that the metallic atoms in many of these phases are arranged in lattices of the most dense spherical packing, it is sought to find the conditions for the existence of the above structures. H. H. Ho.

2331. Crystallisation and Segregation Phenomena in Small Carbon Steel Ingots. A. Hultgren. *Iron and Steel Inst., J.* 120. *pp.* 69–113; *Disc.*, 114–125, 1929. *Engineering*, 128. *pp.* 816–818, *Dec.* 20, *and pp.* 851–852, *Dec.* 27, 1929.

The average composition of the steel examined is C 1·10 %, Si 0·20 %, Mn 0·30 %, P 0·012 %, S 0·009 %. Ingots were cast at 1368–1442°, annealed at about 760° for 15 hours, and then cooled slowly. Slabs with one surface through the axis and perpendicular to the side surface were cut into suitable lengths, polished, and subjected to mild and strong etching. The results are discussed in detail with numerous microphotographs. The outer skin is formed of random crystals followed by a thicker layer of crystals on the average elongated perpendicularly to the freezing isothermal, but interlacing to some extent and throwing out branches parallel to the tetragonal axes of the crystals. This layer is subjected to deforming stresses due to contraction of the steel and expansion of the mould. The interior of the ingot crystallises from independent nuclei with formation of free crystals, for which in quiet conditions some undercooling is necessary, resulting in large skeletons and a large grained dendritic structure. Stirring increases the number of nuclei causing a small grained structure. Between these two portions is a " pasty " zone, movements of liquid through and deformation of which are thought to be a chief cause of segregation. The effects on this of varied working conditions are considered in detail, and the importance of relative movement of any kind between solid and liquid during solidification is emphasised. Segregation is diminished in an ingot with little or no taper at the ends and large taper in the middle. The production of secondary elongated crystals in certain nickel-chromium steels which solidify as δ-iron and transform to austenite is shown to occur. C. A. S.

2332. Coalescence of Pearlite. J. H. Whiteley. *Iron and Steel Inst., J.* 120. *pp.* 147-154; *Disc.*, 155-159, 1929.

The variations in the dimensions of cementite crystals in plain carbon steel which may be induced by heat treatment have been studied. It is shown that coalescence resulting in the formation of cementite borders to pearlite takes place within the small range of temperature in which the γ-iron solid solution transforms to pearlite in hypo-eutectoid steels, and before all the γ-iron is transformed. Coalescence is due to the fact that carbide is transferred by diffusion from the γ-iron to the adjacent pearlite areas. It follows that the longer the time during which the steel is cooling through the Ar_1 range, the greater will the coalescence tend to be. The most marked effects were produced in steels very low in manganese and with samples containing more than 1 %, coalescence was not obtained. C. O. B.

2333. Solubility of Carbide in Ferrite. H. A. Dickie. *Iron and Steel Inst., J.* 120. *pp.* 161-185; *Disc.*, 186, 1929.

The physical effects of the solubility of carbide in ferrite have been investigated in a wide range of steels, including alloys containing up to 7 % of nickel, 2 % of manganese, 5·5 % of chromium, 4·5 % of nickel with 1·5 % of chromium, and Armco iron. Changes due to tempering effects such as spheroidisation, have been eliminated from the results by the methods of heat treatment adopted. Principally the magnetic qualities and the electrical conductivities of the steels are used to estimate the carbide in solution after various treatments. Examination of the curves enables the solubility to be calculated in any particular case. A. A. D.

2334. Hardness of Vacuum-Annealed Crystals of Iron. H. O'Neill. *Iron and Steel Inst., J.* 120. *pp.* 207-233; *Disc.*, 234-238, 1929.

The Brinell hardness of normalised Armco iron was lowered considerably by vacuum-annealing. The ultimate Brinell number was found to be independent of the grain-size, within the limits of experimental error, for strained Armco iron recrystallised *in vacuo*. The Brinell number at different testing loads of vacuum-annealed, decarburised iron was independent of the grain-size, and different faces of single crystals gave the same number as aggregates. Scratch tests proved, however, that different directions on these crystal faces had distinctly different scratch hardness values. "Meyer analysis" of the results of scratch tests suggested that the strain-hardening capacity of iron in the form of aggregates or single crystals increased somewhat as the temperature was raised from − 185° to + 100° C. Attention is drawn to the general correspondence between the property of hardness and that of electrical resistivity. Apparently a marked contradiction to that correspondence occurs when changes of the property due to temperature are considered. C. O. B.

2335. Orientation of Single Crystals of Aluminium. G. Sachs and J. Weerts. *Zeits. f. Physik*, 59. 7–8. *pp*. 497–500, 1930.

Pure aluminium crystallises with the face-diagonal as a preferred direction. Less pure aluminium has no preferred direction. An alloy containing 5 % of copper (not of the highest purity) had, as preferred directions, the cube diagonal and the cube edge. A. A. D.

2336. Recrystallisation of Aluminium. W. G. Burgers. *Zeits. f. Physik*, 59. 9–10. *pp*. 651–655, 1930.

The recrystallisation of aluminium after deformation has been investigated by X-rays. In contradiction to the usual statement, it is found not to be random, but to show an anistropy dependent upon the relative strength of deformation. The anistropic orientation is found to depend upon the process of deformation which preceded the recrystallisation. F. S.

2337. Alleged Allotropy of Bismuth. A. Schulze. *Zeits. f. techn. Physik*, 11. 1. *pp*. 16–23, 1930.

Dilatometric measurement up to 160° C. and electrical resistance measurements up to the melting point show that no transformation occurs in very pure bismuth. This view was confirmed by microscopic examination. It is shown, incidentally, that liquid bismuth just above its melting point has a resistance 0·489 that of solid bismuth just below the melting point. A. A. D.

2338. Mechanical and Magnetic Factors Influencing the Orientation and Perfection of Bismuth Single-Crystals. A. Goetz. *Phys. Rev*. 35. *pp*. 193–207, *Jan*. 15, 1930.

A method is described which permits the production of single crystals of metals, with practically no limit to size or to desired orientation, thus indicating that all external mechanical influences are avoided. Furthermore, the method permits the zone of formation in a growing crystal to be subjected to a strong magnetic field. A systematic study of the conditions in which the seed crystal transfers its orientation to the rod is made. Experiments with artificially distorted seeds, etc., show that crystalline units must already exist in the liquid state. It is shown that this "liquid crystal" is destroyed at about 10° above the melting point. It is suggested that these units are identical with elementary units of a crystal as treated theoretically by Zwicky and observed by the author. Crystals in the three main orientations to the directions of the field lines (20,000 Gauss) were grown, one-half with, the other half without field. No change in the orientation between both halves could be observed as long as no secondary influence was present. However, crystals grown without a predetermined orientation indicated a preference for an orientation in which the direction of the smallest diamagnetic susceptibility (along the trigonal axis) was parallel to the lines of force. The fact that this influence exists, though much smaller than the orienting forces of a seed, supports the assumption of "block-phase" slightly above the melting point. AUTHOR.

2339. X-Ray Analysis of Nickel-Bismuth System. G. Hägg and G. Funke. *Zeits. f. phys. Chem.* 6. *Abt. B.* 4. *pp.* 272–283, *Jan.*, 1930.

X ray analysis and microscopic examination reveal two intermediary phases in the Ni-Bi system. Of these phases that richest in Ni has a narrow range of composition around a mean value between 40 and 50 atomic % Bi. Structurally it consists of a lattice of the nickel arsenide type, made up of equal numbers of atoms of Ni and Bi, the excess Ni atoms being distributed interstitially in this lattice. The lattice dimensions, therefore, increase with decreasing Bi content, and have the minimum values: $a_1 = 4 \cdot 061$ Å. and $a_3 = 5 \cdot 35$ Å. ($a_3 : a_1 = 1 \cdot 32$). The second intermediary phase crystallises in soft needles with hexagonal cross-section, and has practically no range of solid solubility, its composition lying close to $NiBi_3$. The structure has not been determined as the powder photographs are very complex and single crystals are not obtainable. The solid solubilities of Bi in Ni, and of Ni in Bi, are small. A. J. M.

2340. Ternary Silver Alloys. S. Ueno. *Kyoto Coll. Sci., Mem.* 12. *pp.* 347–374, *Nov.*, 1929, *and* 13. *pp.* 91–100, *Jan.*, 1930. *In English.*

Part I. The constitutional space-diagram for the complete Ag-Cu-Zn system is constructed on the results of thermal analysis and microscopical examination. There is no field containing three phases in the solid state, but the β solid solution of the Cu-Zn system unites with that of the Ag-Zn system, and the ϵ phase of the Cu-Zn system similarly with the ϵ of the Ag-Zn system, forming two wide homogeneous ternary fields. Part II. The constitutional diagram is established for the Ag-Al-Zn alloys, rich in Ag and Al. This portion of the ternary diagram is produced by a simple combination of the Ag-Al and Ag-Zn systems: the β phases of the two binary systems unite to form a ternary β solid solution, and there is a continuous field of ternary $\alpha + \beta$ phases. A. J. M.

2341. Ageing of Hardened Metals. J. Galibourg. *Comptes Rendus*, 190. *pp.* 168–170, *Jan.* 20, 1930.

Six specimens from nickel annealed in hydrogen were overstrained and aged for various periods up to 92 days. The ageing temperatures were 15° C., 175°–180° C., and 225°–235° C., and after these ageings the elastic limit was redetermined. The results for straining under a stress of 30 kg./mm.², which is 20 kg./mm.² above the elastic limit, show that the ageing produces an increase in the elastic limit, the time of ageing necessary being considerably reduced for higher temperatures. Five min. at the highest temperature used produce twice the increase obtained at 15° C. with 92 days' ageing. Results are also given of the elongations obtained on a further sample tested by overstraining at 30 kg./mm.², immediately overstraining again at the same stress, heating the sample to 220°–230° C. for 30 min., overstraining again, and, finally, heating for a further 60 min. at the same temperature and overstraining at 32 kg./mm.². Only a slight difference is to be observed between the results for the third and fourth tests on this sample, but the effect of the first ageing by overstraining at room-temperature is most marked, nearly three times the stress afterwards being required to produce the same percentage elongation of 0·16. [See also Abstract 2857 (1929).] R. C. F.

2342. Restoration Processes in Alloys. Part I. Annealing of Super-Saturated Mixed Crystals of β (Cu-Zn). M. Hansen. *Zeits. f. Physik*, 59. 7–8. *pp.* 466–496, 1930.

Alloys containing between 57·5 and 60·5 % of copper were quenched from about 850° C. They were annealed at temperatures up to 400° C., and the electrical resistance and Brinell hardness measured at intervals. Above 350° C. the resistance rises gradually to a constant end value; below this temperature, however, it rises first and then falls. It is concluded that two separate processes are at work: (*a*) lattice modification, (*b*) diffusion. The influence of rate of cooling and quenching temperature has also been examined and the results confirm the views expressed. After quenching the hardness does not commence to rise until the lapse of an appreciable " induction " period. The duration of this period depends on the conditions of quenching and tempering. A. A. D.

2343. Passive State and Overpotential. A. Smits. *Zeits. f. Elektrochem.* 36. *pp.* 20–25, Jan., 1930.

The passivity theory of W. J. Müller [see Abstract 839 (1930)] is discussed from the standpoint of the theory of electromotive equilibrium, and was shown to be untenable. Two new points of view are introduced. The first is the assumption that the formation of ions of different valencies precedes a change in the quantum number of the valency electron orbits. The second point is the influence of the covering of the metal by a porous oxide layer on the stationary potential. Aluminium was investigated and its behaviour shown to be exceptional. The potential curves for aluminium lead to the assumption that the oxide or hydroxide dissolved in the surface of the metal render the removal of the valency electrons difficult, and that the inertia of pure aluminium in this respect must be ascribed to traces of dissolved oxide. A trace of mercury more than compensated this influence. F. J. B.

2344. Quantum Mechanics of Chemical Reactions : Predissociation and Unimolecular Decompositions. O. K. Rice. *Phys. Rev.* 34. *pp.* 1451–1462, *Dec.* 1, 1929.

In an ordinary chemical reaction three processes occur: activation, reaction of the activated product, and deactivation. These processes can be described quantum mechanically, and they must all be taken into account. As an example, the case of pre-dissociation of diatomic molecules is considered. Here activation is by light, and after a lapse of time the molecule decomposes. It is shown that, under some circumstances which are discussed in detail, the wave function immediately after the excitation by light may be completely and correctly described as the wave function of a discrete state, which interacts with a continuum. Here the calculation of the rate of dissociation previously made by Wentzel applies, with some limitations which are discussed. Not all the simplifications which make the case of predissociation easy hold for decompositions of complicated molecules, but something is to be learned by comparing the two cases. The perturbations which give rise to the decompositions are of the same nature as those which occur in the case of predissociation, but they cannot be put into the same equation to give the rate of reaction. The reason for this is discussed, as are some of the questions involved in activation by collision. AUTHOR.

2345. Ionisation Produced in the Oxidation of Nitrogen Dioxide. L. A. M. Henry. *J. Phys. Chem.* 33. *pp.* 1941–1952, *Dec.*, 1929.

The reactions $2NO + O_2 = 2NO_2$ and $2NO_2 = 2NO + O_2$ were studied by a specially designed electrical apparatus capable of measuring currents of 10^{-15} to 10^{-16} ampere. It was found that at room-temperature and at 100° C. no permanent ionisation was produced when the reacting mixture was introduced into the ionising chamber. At 300° C. the reacting mixture and the mixture at equilibrium gave a permanent ionisation of from 10^{-14} to 10^{-15} ampere. The ionisation was proportional to the potential gradient in the chamber, and to the percentage of NO or NO_2. The ionisation was considered to be due to the dissociation of nitrogen peroxide. F. J. B.

2346. Spectral Terms and Chemical Valency. A. T. Williams. *Comptes Rendus*, 189. *pp.* 1075–1077, *Dec.* 9, 1929.

The author has previously established the relation $V = R \pm 1$, where V is the chemical valency and R the spectral multiplicity. This does not agree with the facts for Ga, In and Tl; the anomaly can be interpreted by assuming with Rao that the valency diminishes as the difference between the base terms of the arc spectra $^2P_2 - {}^2P_1$ increases, as shown in the following table:

Element.	$^2P_2 - {}^2P_1$.	Valency.
Al	112·07 cm.$^{-1}$	3
Ga	826·00	2 and 3
In	2212·60	3, 2 and 1
Tl	7792·70	3 and 1

For the elements 57 to 64 from La to Gd, $V = R - 1 - f$ or $V = R + 1 - f$, where f represents the number of electrons in the $4f$ orbits; for the elements from 65 to 71 from Tb to Lu, $V = R - 1 - (f - 2n)$ or $V = R + 1 - (f - 2n)$, in which n varies from Tb to Lu from 1 to 7. In the rare earths increase in the atomic number results from the aggregation of electrons in the $4f$ orbits, which goes to explain the above relations. A table gives the valencies of Si = 4, Ge = 4 and 2, Sn = 4 and 2, Pb = 2 and 4, the fundamental terms of their spectra, $^3P_0$, $^3P_1$ and $^3P_2$, and their differences. The differences increase in the order Si, Ge, Sn, Pb, and the valencies tend to diminish in this direction. H. N. A.

2347. Spectral Terms and Chemical Valency. A. T. Williams and R. Grinfeld. *Univ. Nac. La Plata, Estudio Ciencias, No.* 89. *pp.* 137–171, *Dec.*, 1929.

After a definition of the concepts of valency and of spectral multiplicity, the validity of the relation $V = R \pm 1$ found by A. T. Williams is discussed, applying it to all the atoms of the periodic classification. The relation holds good for all the atoms except those of the rare earths. For these, we have the relations $V = R - 1 - f$, or $V = R + 1 - f$, from

La to Gd, according to the configurations $5d^26s$ or $5d^26s^2$. For the elements from Tb to Lu we have the relations $V = R - 1 - (f - 2n)$ or $V = R + 1 - (f - 2n)$, according to the same configurations. In these formulæ, f is the number of electrons within the orbits $4f$, and n takes values from 1 to 7. The sign in the equation $V = R \pm 1$ is determined univocally by taking into account the quantistic azimuthal number k, the maximum number of electrons which can exist in an orbit, determined according to Stoner's rule $N = 2(2k - 1)$, and the real number of electrons which exist in each orbit. For the elements of the third, fourth and fifth columns which have several valencies, this variation of the valency is discussed in terms of the numerical value of the spectral terms. The memoirs of Heitler and London on the application of undulatory mechanics to chemistry are discussed. London reaches the relation $V = R - 1$ for homopolar valency. In the cases presented by London the authors' results are in accord with London's. The numbers which represent the different valencies (homopolar or polar) of an atom are, to one unit, equal to the numbers which measure its distinct multiplicities from the spectroscopic point of view. A. D.

2348. Wave Mechanics and Homopolar and Heteropolar Bonds. A. T. Williams. *Univ. Nac. La Plata, Estudio Ciencias, No.* 89. *pp.* 183–186, *Dec.,* 1929.

A connection between homopolar and heteropolar bonds is established in accordance with the postulates of wave mechanics, and also with Kossel's theory. In this way a compound can exist in two forms. For example, ClNa can exist as Cl^-Na^+ (heteropolar) or Cl–Na (homopolar). Other examples are considered. AUTHOR.

2349. Equilibria in Sulphur Dioxide Solutions. W. B. Campbell and O. Maass. *Canad. J. of Research,* 2. *pp.* 42–64, *Jan.,* 1930.

The investigation described deals with the equilibria existing in a water solution of sulphur dioxide. The vapour pressures and conductivities of solutions of sulphur dioxide were measured over the temperature range 23° to 135° C. at various concentrations up to 8 %. The densities of the aqueous solutions up to 15 % were also measured. A discussion of the various equilibria in the light of these data leads to the conclusion that sulphurous acid is one of considerable strength, its apparent weakness being due to the small amount of H_2SO_3 actually present. With rise in temperature the free sulphur dioxide increases and the hydrogen-ion concentration of the sulphite liquor used in current practice is so low that it seems highly improbable that the cooking reaction is due essentially to this factor. Apart from the bearing this work may have on the theory of sulphite cooking and the theory of the equilibria existing in the SO_2-H_2O system, it fills a considerable gap in the data regarding sulphur dioxide. AUTHORS.

2350. Thermodynamics of Systems with Several Equilibria. N. v. Raschevsky. *Zeits. f. Physik,* 59. 7–8. *pp.* 562–569, 1930.

A system is investigated which consists of a solution of two substances A and B, between which a reversible reaction $A \rightleftarrows B$ takes place. When the solution is not dilute, the mutual influence of dissolved molecules has to be taken into account. It is shown that on the assumption of strongly decreasing repulsive forces with distance and of weaker decreasing attraction forces, a system may have several equilibria. Certain hysteresis phenomena can then arise, such as are dealt with in a previous paper [see Abstract 1228 (1930)]. H. H. Ho.

2351. Surface Forces and Chemical Equilibrium. H. Freundlich. *Chem. Soc., J. pp.* 164–179, *Jan.,* 1930.

J. J. Thomson's work on the influence of capillarity on chemical equilibrium is first discussed, following which comes a study of the phenomenon that when charcoal is shaken with salt solutions, especially those of salts with organic ions like dyes or alkaloids, the two ions are not always adsorbed in equivalent amounts. In this connection the work of Frumkin and collaborators [see Abstract 2849 (1929)] is reviewed, changes of interfacial tension being found in agreement with Thomson's relation between capillarity and chemical equilibrium. The chemical changes taking place in an interface are discussed at great length, the reactions of indicators being considered. The adsorption of dyes or silver halides is described to show how different interfaces may behave similarly. The author concludes with some remarks on the question as to how far surface reactions are of biological importance. H. H. Ho.

2352. Rule for the Mechanism of Reactions. P. Robinson. *J. Phys. Chem.* 34. *pp.* 207–210, *Jan.,* 1930.

The following rule is proposed for the mechanism of reactions: In an isothermal system, when several reactions are possible, the reaction first taking place is the one giving products of highest entropy. The working of the rule is examined in the two typical systems, sulphur and water, and is found to be justified empirically. Many well-known phenomena furnish additional support for the rule. Thus, it explains the supercooling of liquids and the absence of superheating of solids, and predicts the formation of nascent gases in reactions. Moreover, it would predict the occurrence of the monomolecular reactions, in spite of their strongly endothermic nature, because of the large increase in entropy. It would also deny that hydrogen would react to form helium, in spite of the strongly exothermic nature of the reaction, because of the tremendous decrease in entropy. T. H. P.

2353. Oxidation of Mercury Vapour on Incandescent Platinum. Y. Okayama. *Zeits. f. phys. Chem.* 6. *Abt. B.* 5. *pp.* 355–367, *Jan.,* 1930.

The rate of oxidation of mercury vapour on a heated platinum filament at low pressures is almost independent of the vapour pressure of the mercury, but increases with increasing oxygen pressure, according to the equation: $-\Delta n/\Delta z = \sqrt{p_{O_2}}/(a + b\sqrt{p_{O_2}})$, where $-\Delta n/\Delta z$ is the number of gramme-molecules of oxygen converted to oxide per sq. cm. of platinum surface per second, and a and b are functions of the temperature. The results are discussed in the light of adsorption considerations. The observations do not agree with those of Leipunski, who claims that the reaction velocity is independent of the oxygen pressure, and decreases with increasing mercury pressure. A. J. M.

2354. Gas Luminosity in Heterogeneous Reactions. L. Frommer and M. Polanyi. *Zeits. f. phys. Chem.* 6. *Abt. B.* 5. *pp.* 371–381, *Jan.,* 1930.

The action of chlorine upon aluminium in the presence of copper is found to be accompanied by a luminosity which exhibits cuprous chloride bands. This phenomenon is ascribed to the formation of an active component which behaves as a strongly reducing gas, and is assumed to consist of uncharged particles, probably of a subchloride of aluminium.

H. H. Ho.

2355. Temperature Coefficient of Reactions in Solution. F. O. Rice and H. C. Urey. *Am. Chem. Soc., J.* 52. *pp.* 95–101, *Jan.*, 1930.

An explanation is advanced for the temperature coefficient of reactions in solution, based on Brönsted's theory of reaction kinetics and on current theories for the temperature coefficient of reactions in the gaseous state. It is suggested that there exist a whole series of fugitive complexes of the type postulated by Brönsted, these differing only in energy content. The energy of activation is defined as the difference between the mean energy of the critical complexes which react and the mean energy of all the molecules. When there is only a primary salt effect the temperature coefficient should be independent of the addition of salt. In the case of catalysis by weak acids, several simultaneous reactions, each with its own characteristic energy of activation, may be expected. This is discussed for the catalysis of the acetone-iodine reaction by sulphuric acid, and it is shown that the experimental results are in agreement with the theory. T. H. P.

2356. Studies in Coordination. Part I. Ion-Hydrates. F. J. Garrick. *Phil. Mag.* 9. *pp.* 131–141, *Jan.*, 1930.

The view that the mechanism of coordination is purely electrostatic, depending on the dipole moment and polarisability of the water or ammonia molecule, is adopted and an attempt made in the present paper by quantitative investigation to show that the theory affords an adequate representation of the observed phenomena in the case of ion-hydrates. H. H. Ho.

2357. Chemical Effects of Electrical Discharge in Butane. S. C. Lind and G. Glockler. *Am. Chem. Soc., J.* 51. *pp.* 3655–3660, *Dec.*, 1929.

A quantity of liquid hydrocarbons (1041 cc.) has been prepared from gaseous butane by condensation in an electrical discharge. A system of twelve all-glass ozonisers was used for the purpose. The liquid product obtained was separated into 40 fractions by fractional distillation at various pressures. These fractions consist of very light, medium and also very viscous oils. One of the light fractions was studied in detail and found to have the following properties: b.p. 110–114·0°; index of refraction, 1·4021; density, 0·708; molecular weight, 114·7; percentage of carbon, 84·55; percentage of hydrogen, 15·45; empirical formula, $C_8H_{17\cdot4}$; unsaturation by halogenation, 22·5 mole %. These properties serve to identify this material as a mixture of octanes and octylenes. It is interesting to note that this largest fraction of the lighter oils consists of eight-carbon-atom molecules which can be produced from butane by simple doubling according to theory. AUTHORS.

2358. Equilibrium of the Reaction between Nitrogen and Carbon Dioxide in the Electric Arc. H. V. Tartar and J. L. Hoard. *Am. Chem. Soc., J.* 52. *pp.* 156–163, *Jan.*, 1930.

A mixture of carbon dioxide and nitrogen were introduced into an arc furnace, the arc started and allowed to run for three hours. The gas was then removed from the furnace and analysed. It was found that only small amounts of nitric acid were produced. A current of 65 milliamperes produced only 1/6th of the nitric acid from nitrogen and carbon dioxide as was produced from air. Reduction of pressure had a very slight effect upon the equilibrium. Increase of the current by 50 % produced an increase in the amount of nitric acid formed of 30–40 %. The results indicated that the reaction between nitrogen and carbon dioxide in the arc did not promise to become a means of fixing nitrogen. F. J. B.

2359. Synthesis of Ammonia in the Glow Discharge. A. K. Brewer and J. W. Westhaver. *J. Phys. Chem.* 34. *pp.* 153–164, *Jan.*, 1930.

It has been shown [see Abstract 3679 (1929)] that the rate of synthesis of ammonia in the glow discharge is given by the equation $dP/dt = \alpha I$, where P is defined as the equivalent ammonia pressure, I is the current, and α is a constant independent of P. A further study has been made of the factors influencing α. The results show that α is almost independent of the temperature. Further, for gas mixtures of varying N_2/H_2 ratio, α reaches a maximum when N_2/H_2 is 0·5. Addition of either component to this mixture causes a slowing down in the rate of synthesis, the addition of nitrogen being three times as effective as that of hydrogen. Helium, when added in any quantity up to 70 % of the total gas pressure, had no influence on α. Argon even in slight amounts decreased α considerably. It has also been demonstrated that appreciable synthesis occurs only in the glowing parts of the discharge. The maximum rate of synthesis was found in the negative glow; no synthesis took place in the Crookes and Faraday dark spaces. The positive column, including the anode glow, produced in general a uniform synthesis throughout its length. Analysis of these results shows that the synthesis is initiated principally, if not entirely, by N_2^+ ions. The mechanism of the second step of the synthesis, the union of N_2^+ ion with hydrogen, is not yet clear. Three mechanisms have been suggested; but it is not possible at the present stage of the investigation to distinguish between them. F. J. W.

2360. Limits of Ignition of Mixtures $2H_2 + O_2$ and $2CO + O_2$. D. Kopp, A. Kowalsky, A. Sagulin and N. Semenoff. *Zeits. f. phys. Chem.* 6. *Abt. B.* 4. *pp.* 307–329, *Jan.*, 1930.

The ignition of mixtures of H_2 and O_2, and of CO and O_2 at different temperatures was studied. The progress of the reactions was followed by the changes of pressure. The gases were contained in a cylindrical vessel connected to the pressure gauge, and heated to the desired temperature in an electric furnace. It was found that the reaction $H_2 + \frac{1}{2}O_2 = H_2O$ did not take place at temperatures below 440° C., if the pressure were less than a definite pressure, called "residual pressure." The residual pressure decreased with the temperature. At pressures higher than the residual pressure the reaction proceeded very rapidly. The combustion and the reaction ceased instantly when the partial pressure of the $H_2 + O_2$ reached the maximum pressure p_2. The effect of mixing the reactants with argon and traces of NO_2, and the influence of the dimensions of the reaction vessel were also investigated. The maximum pressure for the explosion of $2CO + O_2$ was determined, and it was found that when this pressure was exceeded ignition of the gaseous mixture was no longer possible.

F. J. B.

2361. Influence of an Electric Field on the Combustion of Gases. A. E. Malinowski and F. A. Lawrow. *Zeits. f. Physik*, 59. 9–10. *pp.* 690–696, 1930.

It has been known for a long time that there is a close connection between the electrical conductivity of a flame and the velocity of propagation of ignition. The effect on the other hand of an electric field on the combustion was only discovered in 1924 by Malinowski. The latter found that combustion of an explosive mixture of benzene vapour and air could be stopped by passing the gas through a charged cylindrical condenser. The paper is a preliminary one on mixtures of CH_4 C_2H_4, and C_2H_2 with air. It describes the apparatus used, and gives the results of the experiments. The authors find that the diminution of the velocity of propagation which is easily observed in the neighbourhood of the saturation point of the conductivity curve, increases with increase in the carbon content of the flame. The explanation of the results obtained is discussed in connection with the work of Haber. T. B.

2362. Dissociation by Collision of Positive Ions. A. Leipunsky and A. Schechter. *Zeits. f. Physik*, 59. 11–12. *pp*. 857–863, 1930.

Experiments on collisions between positive ions of alkali-metals with hydrogen molecules have shown that the latter are dissociated whenever the ions possess energy sufficiently great. In this case, therefore, activation by collision of rapid particles has been experimentally established. The values of activation-energy of this reaction leads to the hypothesis that dissociation appears as a secondary process, the primary one being excitation of the hydrogen molecule. H. H. Ho.

2363. Reaction between Hydrogen and Oxygen. D. Alexejew and D. Awanessow. *Zeits. f. Physik*, 59. 11–12. *pp*. 864–871, 1930.

It is shown experimentally that the cessation of the propagation of the reaction wave in explosible mixtures of hydrogen and oxygen at fixed temperatures and pressures enables the computation of the maximum existence period of an excited hydrogen atom, which is now found to be about 10^{-9} sec. H. H. Ho.

2364. Action of Light of Different Wave-Lengths on Nitrocellulose. H. B. Devore, A. H. Pfund and V. Cofman. *J. Phys. Chem.* 33. *pp*. 1836–1842, *Nov*., 1929.

Spectrographic investigation of the action of light on nitrocellulose as a function of the wave-length shows that thin films (0·001 mm.) are gradually decomposed by light of wave-length 190–260 $\mu\mu$. When thicker films containing acidity indicators are used, the acidity is increased by light of wave-length 230–600 $\mu\mu$, the effect showing a marked maximum at about 313 $\mu\mu$. In the same region the imbibing power of the films also undergoes increase. Brittleness is produced by wave-lengths in the neighbourhood of 254 $\mu\mu$ much more rapidly than by longer wave-lengths. T. H. P.

2365. Temperature Coefficient of Photochemical Formation of Hydrogen Chloride. O. R. Wulf. *Nat. Acad. Sci., Proc.* 16. *pp*. 27–32, *Jan*., 1930.

The purpose of this paper is the calculation of the variation of photochemical temperature coefficient with wave-length under the simplified conditions given by the photochemical combination of hydrogen and chlorine, where chlorine is the only photochemically active constituent, and where it is a reasonable assumption that the necessary primary photochemical act is the dissociation of the chlorine molecule. It is found that over the longer of the wave-lengths to which it is sensitive, the above reaction appears to illustrate Tolman's theory in its simplest form, the influence of temperature being an important part in its effect on the absorption of light by the photochemically active constituent. For cases of small fractional absorption, elementary band-spectra theory gives considerable information regarding the relation of wave-length to photochemical temperature coefficient. H. H. Ho.

2366. Absorption of Infra-Red Radiations and the Activation of Molecules in Chemical Reactions. N. R. Dhar and A. K. Bhattacharya. *Faraday Soc., Trans.* 26. *pp.* 1–6, *Jan.*, 1930.

Extinction coefficient measurements show that all radiations from 7000 Å. to 4400 Å. are absorbed by aqueous solutions of neocyanin and of mixed chromic and citric acids, as by numerous other reacting substances. These radiations accelerate the reactions because by their absorption the reacting molecules are activated. A measure of the number of active molecules present is provided by the shift of the absorption line towards shorter wave-lengths, which can occur with fluorescent as well as scattered radiations. The wave-length calculated from thermal temperature-coefficients should be regarded as the threshold limit: the threshold frequency is the minimum frequency necessary for the progress of the reaction. Photosensitivity and increase of absorption of light are closely associated. The two important factors in the relation between intensity and velocity of reaction are the amount of absorption of the incident radiation by the reactants, and the acceleration of the reaction in presence of light. The quantum yield of a reaction can be changed by variations in experimental conditions. The observed acceleration of reactions involving halogens by radiations of wave-length 7304 Å. suggests that the halogens are not first atomised on illumination. A. J. M.

2367. Heat of Dissociation of the Oxygen Molecule and the Energy of Activation of the Oxygen Atom. V. Henri. *Comptes Rendus*, 190. *pp.* 179–181, *Jan.* 20, 1930.

The absorption spectrum of gaseous nitrogen peroxide is composed of two regions: the first, from the red to about 2900 Å., consists of a large number of bands and fine lines, which, between 3800 and 3700 Å., become soft and continuous, and corresponds with the first limit of predissociation of the NO_2 molecule; the second, between 2600 and about 2200 Å., consists of a series of bands with a fine double-rotation structure between 2600 and 2459 Å., at which the fine structure suddenly disappears, this being the second predissociation limit. Thus, nitrogen peroxide dissociates into NO and an atom of normal oxygen at λ3700 Å. or an atom of activated oxygen at λ2459 Å., the respective heats of these reactions being $-$ 77,000 and $-$ 116,000 cal. The heat of the dissociation $O_2 \rightarrow O + O$ is $-$ 136,000 cal. (5·5 volts) and the energy of activation of the oxygen atom $-$ 39,000 cal. (1·7 volts). The first state of activation of the oxygen atom corresponds with passage from the normal $^3P_2$ state to the metastable ^1D state. The position of the ^1D term is considered in relation to the green ray of the aurora borealis. [See also Abstract 343 (1928).] T. H. P.

2368. Electrocapillary Properties of Amalgams. A. Frumkin and F. J. Cirves. *J. Phys. Chem.* 34. *pp.* 74–85, *Jan.*, 1930.

It has been shown [see Abstract 341 (1929)], with the help of the " null solutions " method, that an addition of thallium and cadmium to mercury causes a shift of the point of zero charge towards higher values of the potential difference between solution and metal. The data obtained with thallium analgams (*loc. cit.*) agree with the results of the determinations of electrocapillary maxima which confirms the validity of the Lippmann-Helmholtz equation in the case of amalgams. H. H. Ho.

2369. Measurement of Hydrogen Overpotential by the Dropping Mercury Kathode. W. V. Lloyd. *Faraday Soc., Trans.* 26. *pp.* 12–15, *Jan.,* 1930.

The discrepancy between the values obtained for $dw/d\log i$ by Herasymenko, 0·087 volt, and by Bowden, 0·22 volt, was investigated. It was found that w varies logarithmically with i for any solution, provided that the rate of dropping was kept constant, that the current was measured at corresponding periods during the formation of the drop, and that it was measured after the same interval from the beginning of the experiment. Variations of over 100 % were found in the values for $dw/d\log i$ determined for different solutions, and it was concluded that the mechanism of the dropping electrode was too complicated to render it suitable for the study of hydrogen overpotential. Hydrogen gas could not be obtained from a dropping electrode in alkaline solution. F. J. B.

2370. Overpotential of Arsenic and Yields of Arsine at an Arsenic Kathode in Acid Solutions. W. V. Lloyd. *Faraday Soc., Trans.* 26. *pp.* 15–18, *Jan.,* 1930.

The polarisation of arsenic was investigated by a commutator method previously used in similar work on antimony. It was shown that the high overpotential, obtained when arsenic was initially polarised at low current densities, was not maintained at higher current densities. A maximum of over-potential was obtained when no arsine was formed. With continued electrolysis an arsenic kathode passed into an "active" state when arsine was evolved. The percentage of arsine produced electrolytically from solutions of sulphuric, hydrochloric, phosphoric and tartaric acids at a given current density, was approximately independent of the acid employed and of its strength. F. J. B.

2371. Hydrogen Overpotential in Acid Solution. H. J. S. Sand. *Faraday Soc., Trans.* 26. *pp.* 19–26, *Jan.,* 1930.

The dependence of hydrogen overpotential on current density in acid solution, both for low values, when the overpotential is independent of H-ion concentration, and for higher values when it increases logarithmically with it, is explained by the intermediate formation of an ion $H_2^{\cdot}$, or is expressed as H . H, where H denotes a proton and the dot (.) an electron. This ion is known to exist in positives ray tubes. It is assumed that this process takes place exclusively at the interface electrode-electrolyte, and the surface concentrations are related to the equilibrium concentration in the body of the liquid by the Freundlich isotherm. The constitution of the double layer is discussed and it is supposed to be capable of existence in two forms. A random distribution of ions or electrons is assumed for the lower overpotentials, and for higher overpotentials the ions and electrons are considered to be combined in doublets. An explanation is given of the conclusion arrived at experimentally by Bowden and Rideal, that polarisation capacity is independent of the material of the electrode.

F. J. B.

2372. Oxidation Potential of Lead-Dioxide Electrode in Perchloric Acid Solution. D. J. Brown and J. C. Zimmer. *Am. Chem. Soc., J.* 52. *pp.* 1–6, *Jan.,* 1930.

The possible sources of error in previous measurements of the potential of the lead-dioxide electrode were discussed. The different methods of preparing lead dioxide were tested against the electrodeposition of lead dioxide from nitric acid solutions of lead nitrate. It was found that lead dioxide gave a high or low initial value for the potential depending upon whether the dioxide was prepared by chemical or electrolytic methods. Values were subsequently obtained which agreed to within a millivolt or two with the average value given by a number of electrolytic lead-dioxide electrodes. The standard oxidation potential of Pb^{++}/PbO_2 in molal H^+ was measured by two methods and found to be $1 \cdot 467 \pm 0 \cdot 003$ volts.

F. J. B.

2373. Behaviour of Glass Electrodes of Different Compositions. D. A. MacInnes and M. Dole. *Am. Chem. Soc., J.* 52. *pp.* 29–36, *Jan.* 1930.

Glass electrodes were made by fusing the glass under investigation on to a pyrex-glass tube and blowing out to a thin bubble, the glass being blown thin enough to show interference colours. The tube was partially filled with $0 \cdot 1$ HCl, and into this was inserted a silver-silver chloride electrode. The electrodes were employed for H-ion determinations, and various glasses were tried for their suitability as electrodes. The best glass tested had the composition SiO_2 72 %, Na_2O 22 %, CaO 6 %. The hydrogen potential at the surface of this glass changes quantitatively with the H-ion activity up to *p*H values of $9 \cdot 5$, though this limit is lowered by strong salt solutions.

F. J. B.

2374. Sensitive Method for Comparing Electrolyte Resistances at High Frequencies. A. Deubner. *Phys. Zeits.* 30. *pp.* 946–948, *Dec.* 15, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.,* 1929.

While previous methods for comparing electrolyte resistances at high frequencies depend in general on a damping process, the present method depends on compensation. Full experimental details with diagrams are included.

H. H. Ho.

2375. Theory of the Separation of Chromium from Aqueous Chromic Acid Solutions. E. Müller and O. Essin. *Zeits f. Elektrochem.* 36. *pp.* 2–9. *Jan.,* 1930.

Electrolytic experiments with chromic acid solutions up to the point at which hydrogen is evolved show that the slightest kathodic polarisation causes the formation at a perfectly bright electrode of an invisible, orientated diaphragm of basic chromium chromate with the basic constituent towards the kathode and the acid constituent towards the anode. This diaphragm does not admit of the passage of the chromic acid into its pores. As kathode polarisation increases, the H-ions are drawn more and more into the pores of the diaphragm, but so long as the force remains insufficient to draw in the anion as well, no solution of the diaphragm substance takes place. The kathode potential necessary for this increases with the diameter of the anion and with the large anions, $HCrO_4'$, ClO_4' and H_3PO_4' the potential of hydrogen is insufficient. It is, however, sufficient for smaller anions such as F', Cl', NO_3', ClO_3' and HSO_4', so that reduction of chromic acid occurs in presence of these. Electrodes do not possess ideal plane surfaces, showing curvatures, edges and points, at which no complete diaphragm can form, so that the disjointed diaphragm arising allows of the penetration of the $HCrO_4$ ions by free diffusion, or electrostatically.

T. H. P.